POWER

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ELY C. HUTCHINSON, *Editor*

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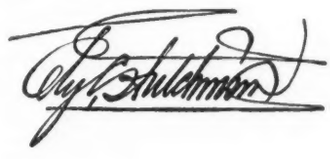
Buyer and Seller Relations

What Mr. James A. Farrell said recently of the steel industry might have been repeated with equal emphasis for almost any business, and certainly for the business of making power. His talk was on the evils of a price-cutting stampede in the steel industry and postulated an unhealthy situation between buyer and seller. He blamed the "big chiefs" more than the salesmen.

Certainly prices will not hold without strong selling courage on the part of industry, but it doesn't do to blame the selling agent altogether. Of course, there are both kinds of sellers. There are also two kinds of buyers.

Moreover, the advantage of business psychology is generally on the side of the purchaser, and the greater temptation to capitalize it is apparent in that group. What this amounts to and how it has been used and misused and where the seller finds himself as a resulting development of these parlous times will be discussed commencing next week.



EDITORIALS

Saved—
One Billion Dollars

One million dollars saved a thousand times. This is the fuel record of American central stations since 1919. W. C. Mendenhall, speaking for the United States Geological Survey, sponsors the statement.

In a bulletin recently issued, he pointed to the fact that during this period the yearly kilowatt-hour output increased 150 per cent, whereas the coal consumption increased only 31 per cent. The grand saving of one billion dollars for the twelve-year period is based on a coal price of $4 per ton.

Here we see the concrete result of technical advances that have reduced the average fuel consumption per kilowatt-hour from 3.2 lb. in 1919 to 1.62 lb. in 1930. This is the cumulative effect of many factors: higher pressures and temperatures, more efficient turbines, bleeder heating and air heaters are some of the more prominent. Back of these lie the continued efforts of engineers not afraid to venture.

The whole power field and the public at large have benefited by the resulting lower cost of electricity. For the industrial plant it has in some cases reduced the cost of purchased current. At the same time, the industrial plant, profiting by the technical advances in central staiton practice, has been enabled to generate its own current more cheaply.

In this symphony of general benefit through better utilization of fuel there is but one discordant note. Undoubtedly it has contributed to a decade of hard times in the coal industry.

Coal operators may take what solace they can find in the fact that future coal savings must necessarily be less than those of the past and that the national kilowatt-hour consumption will increase continually.

A Program of Stabilization

The bituminous coal industry is in a bad way—it has been so for a long time. Progressive economies in utilization, excess productive capacity, chaotic labor policies, inadequate merchandising practices, and, more recently, competition from natural gas, have all combined to create a situation, serious in itself, but intensified by the present depression.

Among users there are many who, remembering the sellers market and accompanying high coal prices of eight to ten years ago, will have little sympathy with the present difficulties of the coal industry, and who are content to reap the advantages of a buyer's market. Yet it must be remembered that, despite the more or less temporary intrusion of competitive fuels, coal is our basic fuel and is likely to continue so. No industry can continue indefinitely to render adequate service to the public and to deal fairly with those whose capital and labor are invested in it without a fair profit. Therefore, some form of stabilization is fundamentally as important to the buyer as it is to the producer.

With this in view, "The Stabilization Program for the Bituminous Coal Industry" as offered in the September number of *Coal Age* should command serious consideration by all concerned. The program covers production control, sound merchandising, stabilized industrial relations, more mechanization, coordinated research to develop new uses for coal, more consolidations, and greater safety.

None of the proposals is basically new, nor is the program held up as a panacea of all the ills of industry. It does, however, represent a viewpoint detached from the many conflicting individual interests within the industry itself, and reflects the composite thinking of the best-informed minds. It is both timely and constructive.

Electric Steam Generators

Steam cannot be economically produced by electric steam generators from power as sold at the usual kilowatt-hour rates. There are, however, several conditions under which they may be used economically. In Canada and Newfoundland there is sufficient electric steam boiler capacity installed to absorb about one and one-half million kilowatts and their use is on the increase.

They have been used extensively to absorb large blocks of hydro-electric power for which there is not an immediate market. In some cases such installations have supplied entire steam demands of large industrial plants. When large blocks of power are purchased on a horsepower-year basis, electric steam boilers are used to absorb excess power not required by the industrial load up to the amount of the contract. A third application is where power companies, operating hydro-electric plants, utilize power produced from excess water. This power is sold at a rate to compete with steam supplied by fuel-fired boilers in industrial plants. In this application electric steam generators improve the load factor of hydro plants and provide a market for power that would otherwise run to waste over the spillway.

Power loads in Canada have been affected adversely by present business conditions as they have been in the United States. To partly compensate for this loss of load and revenue some power companies in Canada are installing electric steam generators in industrial plants

and selling excess power as steam at rates that make it advantageous not to burn fuel. These rates are considerably lower than obtained for the power for industrial loads, but a market is provided for power that is available and would otherwise be a complete loss.

Electric steam boilers have not been used in the United States as much as in Canada. This can be accounted for by the difference in economic and other conditions involved in water-power development in the two countries. However, the present business situation has materially changed this. It would therefore be advisable for those operating hydro plants or purchasing power from them in the United States to study their particular conditions carefully. What our Northern neighbors are doing to use some of their excess power may have an economic place in some plants in this country and provide a source of revenue that has been overlooked.

Welded Diesel-Engine Frames

Welded diesel-engine frames have been tried here and there, but found wanting, principally in respect to vibration. The more ponderous cast structures have greater shock-absorbing capacity.

But welding, gaining rapidly in so many fields, will not pass this by. From England comes a highly ingenious design of welded frame that may have a profound influence on diesel construction everywhere.

An outline of this design, first described and illustrated in the July 17 number of *Engineering,* appears in this number of *Power.*

Engineering vouchsafes no information regarding the action of this new frame when subjected to heavy vibratory stresses. Its performance will be watched with great interest; lower weight and cost are of great importance to diesel manufacturers, but freedom from excessive vibration must come first.

Electricity for Building Heating

Electricity has been looked upon by many engineers as an ideal source of energy for building heating. Its use eliminates the dirt and dust accompanying coal-fired boilers, it is capable of close regulation, and requires a minimum of operating attention. But the cost of electric energy has been the one factor that has militated against its use.

In attempts to decrease cost thermal storage systems have been developed that take advantage of low rates charged for off-peak energy by some utilities. Installations of such systems have been made in England and the United States.

The Lord Kelvin heat pump, employing reversed refrigeration, which makes available for building heating about three times the heat equivalent of the kilowatt-hour energy consumption, has been discussed as another way to reduce the cost of heating by reducing energy consumption. The first heating system of any size to utilize this principle has been installed in the new office building of the Southern California Edison Company, and was described in the Sept. 8 number of *Power.*

Considerable thought and care appears to have been taken to provide all of the instruments and meters necessary to obtain reliable information concerning the cost of operation, so that the results can be applied to buildings situated in more severe climates. The results of this winter's operation will be awaited by utility engineers because it may open an opportunity to develop a large utility load, and by heating engineers because, if economically successful, it may revolutionize the heating and ventilating industry.

Maintaining Operating Methods

Some years ago maintenance was thought of as work done on Sunday, the only time the overloaded equipment could be taken off the line for a few needed repairs.

Systematic plant operation and better ratios of capacity to peak demand have modified this somewhat, and have resulted in more ordered and better scheduled systems of plant maintenance. Even the best-planned of maintenance schedules, however, give way somewhat under the stress of long-continued high-load activity.

Operating methods, likewise, tend to slip and economy becomes subordinated under the strain of carrying the load. Habits of operation are found which outlast the emergency and plant operating methods become as badly in need of repair as does the plant equipment.

Many plants, having passed through such a high-load period prior to the present depression, are experiencing a material slacking off in load, and are now using this economic "Sunday" to catch up on plant maintenance.

Unless our economic soothsayers have lost the gift of prophecy, we will, before long, be again approaching a period of industrial activity in which economy will be a prime requisite and each item of production cost will be critically watched. Manufacturers are becoming "power-conscious" and the power item will be scrutinized more closely than ever before. Not only will the load have to be carried, but it will have to be carried economically.

The present off-peak period offers opportunity for checking up and repairing operating methods to meet the strain on plant economy that is coming.

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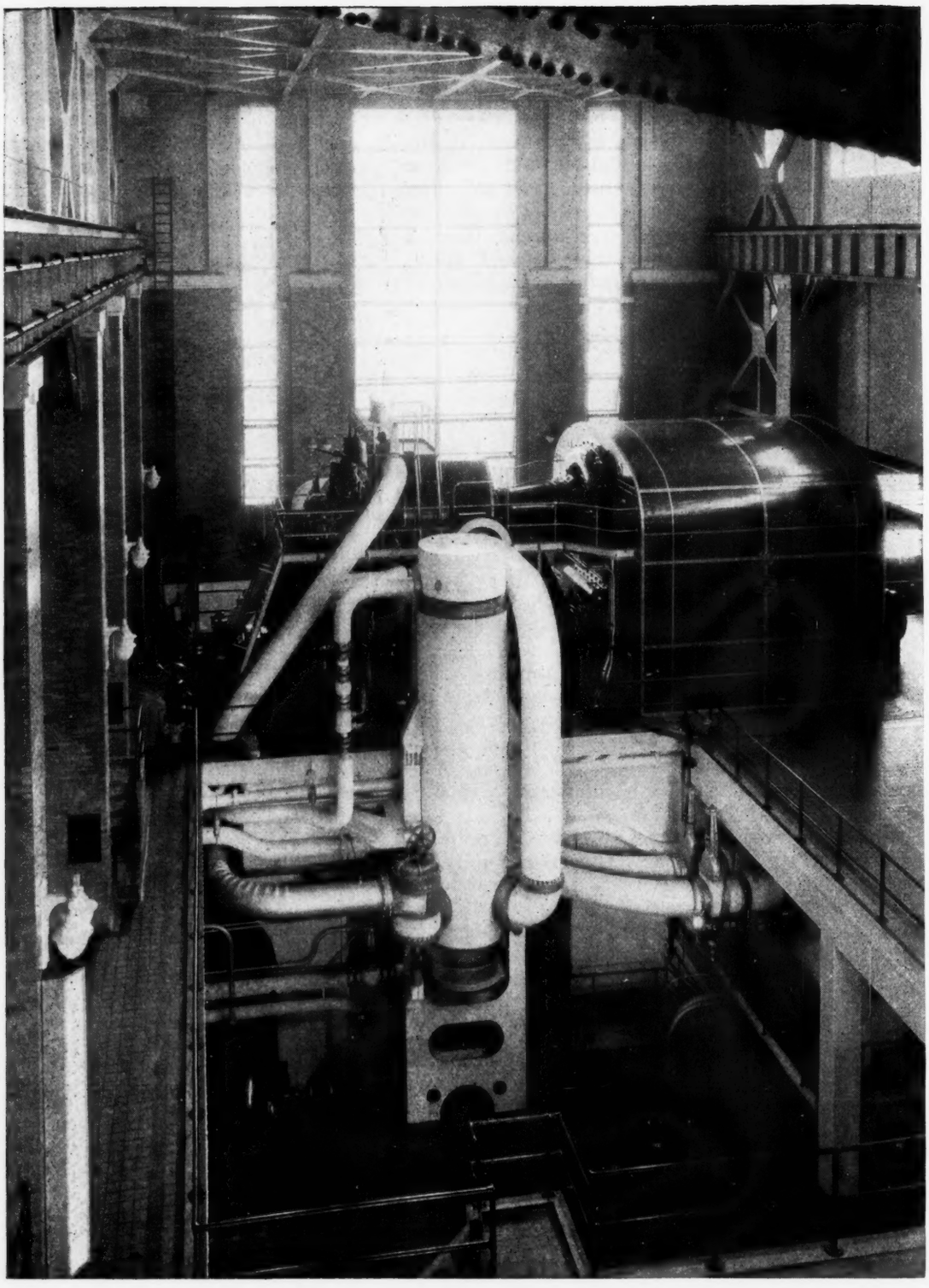
POWER Stands for . .

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application
8. Prevention of Smoke, Within Reason



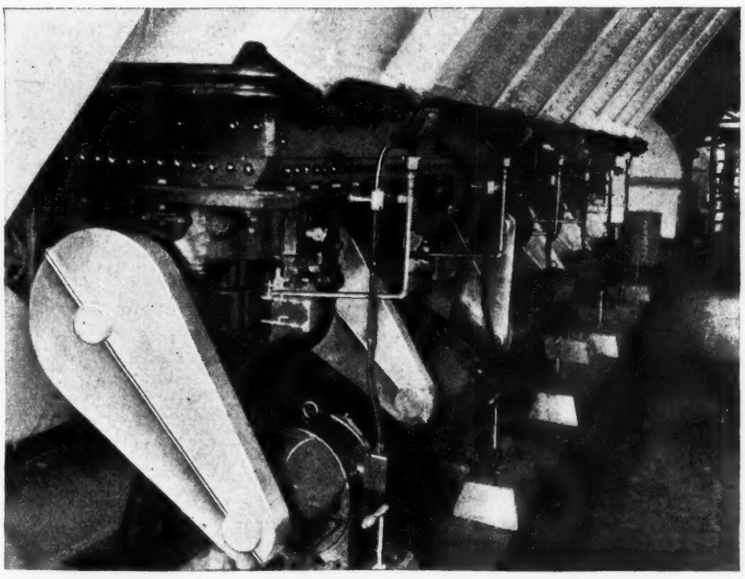
The vertical-compound turbine-generator with one of the vertical live-steam reheaters in the foreground. At the bottom left of the reheater is the multi-ported relief valve on the interturbine steam

The new 110,000-kw. vertical-compound turbine-generator at the River Rouge plant of the Ford Motor Company takes steam at 1,215 lb. pressure from the world's largest 1,400-lb. boilers. The latter burn pulverized coal and blast-furnace gas simultaneously

Ford High-Pressure Unit Now in Operation

DURING the week of July 20 the 110,000-kw. vertical-type turbine-generator in the Rouge plant of the Ford Motor Company at Dearborn, Mich., was turned over and subjected to a load of 30,000 kw. The operation was entirely successful. Starting off at 800 lb., the boiler pressure was raised to 1,400 in the course of 48 hr. to supply the turbine with steam at 1,215 lb. and a temperature of 725 deg. As none of the usual troubles developed in the tuning-up process, some ten days later the load was raised to 60,000 kw., and the machine will operate at this point until the bus system has been revamped to care for the full capacity of the unit.

In the Dec. 24, 1929, number of *Power* the general design of the unit, including the two 700,000-lb.-per-hour boilers and the turbine-generator, with the respective auxiliaries, was covered in a preliminary description. At the present writing additional physical data and subsequent details are available. The illustrations show primary equipment by far the largest ever laid down for the pressure. Details of size, speed and performance appear in the accompanying table.



Motor Driven Coal Feeders

Pulverized Coal and Blast-Furnace Gas Burned Simultaneously

For the convenience of readers it will be desirable to review briefly some of the salient features. Two double-set Ladd boilers each generate 700,000 lb. of steam per hour at a pressure of 1,400 lb. and a final temperature of 750 deg. F. Pulverized coal of 14,000 B.t.u. per pound supplied from an existing preparation house and blast-furnace gas of 95 B.t.u. per cubic foot are burned simultaneously. At the foregoing rating the heat release in the furnace averages about 27,000 B.t.u. per cubic foot. The guaranteed operating efficiency is 86.5 per cent, and it is anticipated that a kilowatt-hour will be produced on approximately 1 lb. of coal, or on 13,000 to 14,000 B.t.u. As may be seen in an accompanying photograph of the interior of the furnace, the gas is introduced through burners, one located centrally in each of the two fronts of each boiler. There are twelve coal burners per boiler, divided into four sets to provide an upright row of three burners in each of the four corners of the furnace below the level of the gas burners. They point tangentially toward an imaginary circle at the center of the furnace to form a whirling vortex of flame.

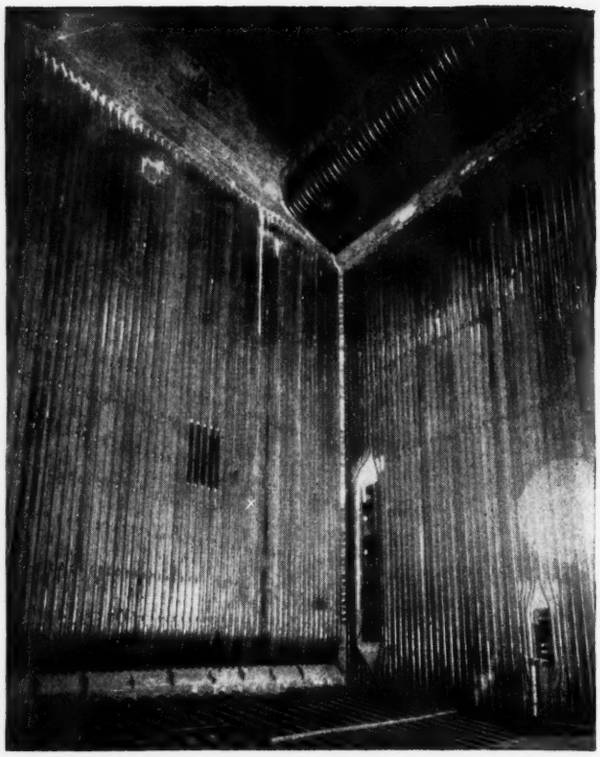
Arrangement of the boiler unit is shown in the sectional elevation. The furnace is protected by vertical finned tubes, as are the arches under the lower drums, and plain tubes form a bottom water screen. There is an economizer with fin tube surface over each uptake of the double-ended boiler and above the economizers are duplicate air heaters of the vertical-plate counterflow type. Two induced-draft fans, each having a capacity of 210,000 cu.ft. per minute, driven by two-speed motors, discharge the

gases directly into the base of the stack. Four 50,000-cu.ft. per minute forced-draft fans, also driven by two-speed motors, draw the warm air from the top of the boiler room and discharge it through the preheaters to the furnace wall ducts and the burners. Two blowers of like capacity supply the primary air carrying the fuel to the furnace.

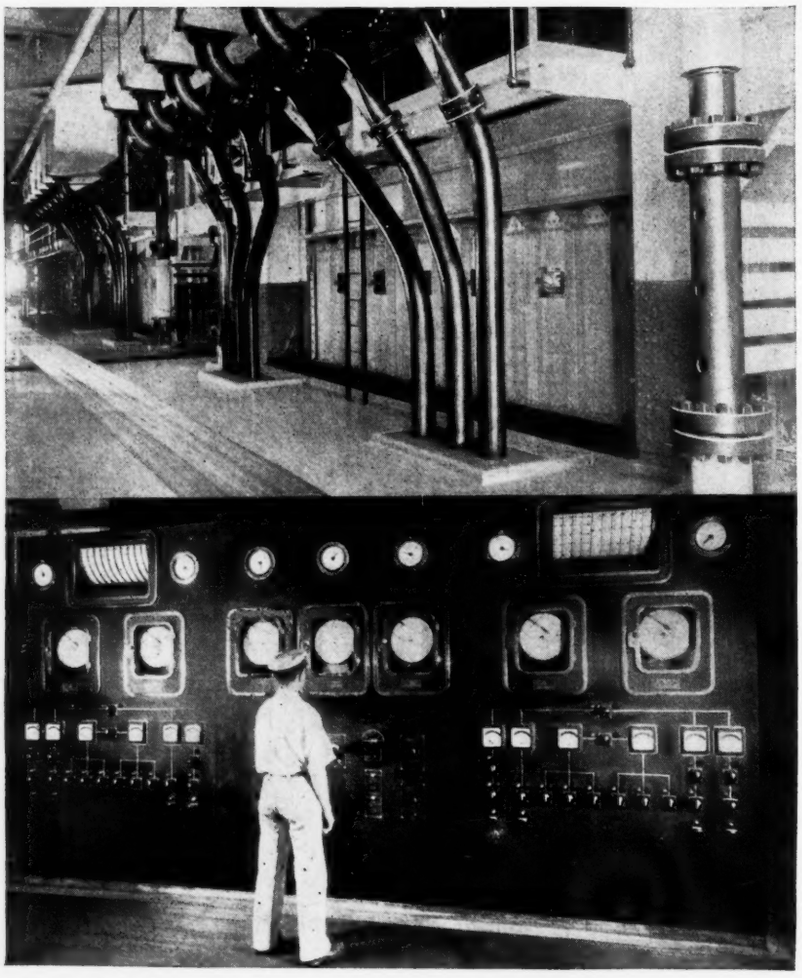
Unit Occupies 0.013 Sq.Ft. of Floor Space per Kilowatt

From the previous account it will be recalled that the vertical-compound turbine-generator has a capacity of 110,000 kw. at 90 per cent power factor. The high-pressure element is mounted above the low-pressure machine, and the same arrangement applies to the separately excited 55,000-kw. generators, which are identically wound for the production of three-phase 60-cycle current at 13,800 volts. The floor space occupied by the unit approximates 0.013 sq.ft. per kilowatt of rating, and the space above the floor line imposed by maximum dimensions is close to ¼ cu.ft. per kilowatt.

The high-pressure turbine has twelve stages, and the double-flow low-pressure element ten stages on each side of a central steam admission. Between the turbine elements two vertical live-steam reheaters raise the steam from 317 to 550 deg. F. The exhaust from the high-pressure turbine is divided equally between the two reheaters, located one on each side of the unit. A multi-ported relief valve on the inter-turbine steam provides emergency relief to the condenser.



Interior of furnace, showing gas burner in one boiler front and one of the three burner groups for pulverized coal at the corner

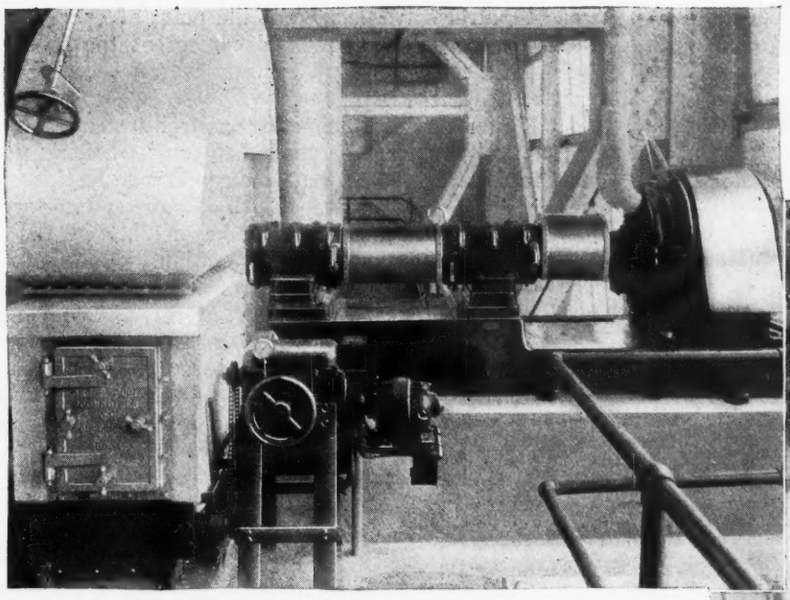


Above—Coal burner supply piping at level below feeders and point of introduction of preheated air. Below—Individual boiler control board for one of the high-pressure boilers

Throttle pressure is 1,215 lb. abs. and the steam temperature 725 deg. F. Steam pressure into the low-pressure turbine will approximate 85 lb. abs. A single-pass condenser serves the unit. Cooling water brought by a new tunnel[1] from the Detroit River is supplied by two motor-driven circulating pumps, each of 80,000 gal. per minute capacity.

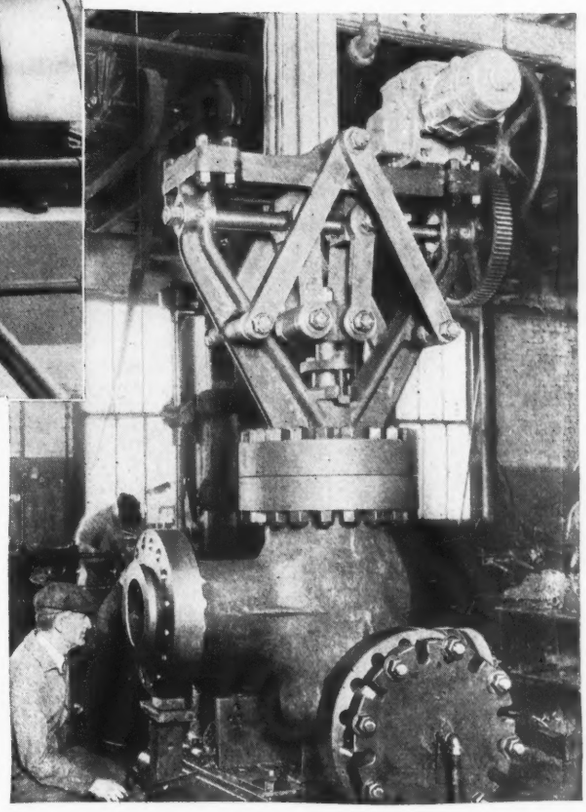
In the previous story a heat balance diagram of the unit showed four stages of bleeding to heat the feed water: one from the high-pressure turbine at 320 lb. abs.; the second from the crossover connection at 85 lb. abs.; and the remaining two from the low-pressure turbine at 31.5 and 8.8 lb. abs., respectively. Condensate from the hotwell is forced through the generator air coolers, the air ejector condenser and the low-pressure closed heater to the receiver preceding a deaërating heater. Distilled water also may be introduced at this point from either of two single-effect evaporators complete with heat interchangers. From the deaërating heater three booster pumps per boiler, with an operating range from 35 to 780 lb. abs., force the boiler supply through the crossover and high-pressure heaters and a reheater drip cooler

[1]For description of tunnel see *Power*, Sept. 17, 1929.



Primary-air fans on feeder deck

Shop view of one of the two 12-in. angle non-return valves for the 1,400-lb. boilers. The assembled valve weighs more than five tons and stands over 10 ft.



to the boiler-feed pumps, which force the water to the economizers at a temperature approximating 437 deg. F. There are three of these pumps per boiler and, as in the case of the booster pumps, two are motor-driven and one directly connected to a steam turbine.

Elaborate Control System Installed

Operation of the Bailey automatic combustion control as applied to the boilers is interesting. There is the possibility of push-button control, automatic control or manual operation on the fuel and air at each boiler. From the master drum switch, push-button control may

Physical Data and Performance of New Unit

Boiler:
- Type ..... Ladd double set
- Surface, sq.ft. 32,040
- Pressure, lb. gage 1,400
- Steam temperature, deg. F. 750
- Height of centerline upper middle drum above floor, ft. 72
- Shipping weight, lb. 1,120,000
- Efficiency, over-all, per cent 86.5

Combustion chamber:
- Furnace dimensions, ft.-in. .....25-8 x 26-8 x 36-6
- Volume, cu.ft. 28,500
- Heat release supplying 700,000 lb. steam, B.t.u. per cu.ft. 27,000
- Surface in 118 fin-front tubes, sq.ft. 1,840
- Surface in 118 fin-arch tubes, sq.ft. 600
- Surface in 124 fin-side tubes, sq.ft. 1,960
- Surface in 59 plain-bottom tubes, sq.ft. 730
- Total surface in furnace, sq.ft. 5,130

Superheater, 172 elements, sq.ft. 11,475

Economizers, 2 per boiler, fin-tube type total surface, sq.ft 14,000

Air heaters, 2 per boiler, vertical-plate counter-flow, 180 elements total surface, sq.ft. 64,800

Fans, forced-draft, 4 per boiler, 50,000 c.f.m. at 100 deg. each; pressure, 10.32 in. w.g.; 60-150 hp.; 900-1,200 r.p.m

Fans, induced-draft, 2 per boiler, 210,000 c.f.m., at 400 deg. each; pressure, 12.5 in. w.g.; 500-800 hp.; 514-400 r.p.m.

Fans, primary-air, 2 per boiler, 36,000 c.f.m. at 400 deg. each; pressure, 16 in. w.g.; 100-hp.; 1,200 r.p.m.

Pumps, booster, 3 per boiler, 1,480 g.p.m., 1,720 r.p.m.; 1,920-ft. head, 1,000 hp.; two motor- and one turbine-driven.

Pumps, feed-water, 3 per boiler, 1,650 g.p.m., 1,780 r.p.m., 2,120 ft. head, 1,250-hp., two motor- and one turbine-driven.

Heater, deaërator with vent and after condensers; capable of heating 1,000,000 lb. per hr. from 175 to 246 deg. F.; steam supply at 28.15 lb. abs.

Heaters, 3, closed, surface type; low-pressure heater capable of heating 707,250 lb. water per hour from 93 to 175 deg. F., steam supplied at 8 lb. abs. crossover heater capable of heating 903,402 lb. of water per hour from 246 to 304 deg. F., steam supplied at 79 lb. abs.; high-pressure heater capable of heating 903,402 lb. of water per hour from 304 to 407 deg. F., steam supplied at 289 lb. abs.

Evaporators, make-up, 2 single-effect, each having capacity to evaporate 20,000 lb. per hr.; steam supplied at 81.5 lb. abs. and vapor delivered at 28.5 lb. abs.

Turbine: Vertical compound; high-pressure element, 10 stages; low-pressure element 10-stage double-flow; speed, 1,800 r.p.m.; two generators, each 55,000 kw., 3-phase, 60 cycles, 13,800 volts.

Performance: Throttle pressure 1,225 lb., temperature 725 deg. F.; exhaust press. at horse-power end, 85.5 lb.; steam reheated to 550 deg. F.; 4-stage bleeding at 320, 85.5, 31.5 and 8.8 lb. Throttle water rate, 8.93 lb. per kw.-hr., or 9,675 B.t.u. per kw.-hr., at 111,940 kw. output.

Unit dimensions: Length over throttle valve, 60 ft. 10 in.; length at floor 57 ft.; width of turbine, 21 ft.; width of generator, 26 ft.; height of generator to top of ventilating housing 22.5 ft. Floor area per kilowatt of rating, 0.013 sq.ft.; volume imposed by maximum dimensions, ¾ cu.ft. per kw. of rating.

Unit weights: Net weight of unit, 1,885,000 lb.; weight of horse-power turbine rotor, 31,500 lb.; weight of low-pressure turbine rotor, 110,000 lb.; weight of horse-power generator stator, 325,000 lb.; weight of low-pressure generator stator, 374,000 lb.

Condenser: Single-pass, surface, 77,000 sq.ft.; weight of condenser erected 603,600 lb.; weight of water in service 173,050 lb.

Circulating pumps: Two with combined capacity of 123,000 g.p.m. against dynamic head of 17 ft.; pump efficiency 85 per cent; 335-hp. motors; syn, sp., 200 r.p.m.

Hotwell pumps: Two of 2,000 g.p.m. each against 225 ft. head; 200-hp. motors; syn. sp., 900 r.p.m.

Steam air ejectors: Two double ejecting units each consisting of two 2-stage elements; steam supplied at 250 lb. gage, 650 deg. F.

Reheaters: Two live steam, vertical, each capable of reheating 396,000 lb. steam per hour at 317 deg. F. to a temperature of 550 deg. F.; heating steam supplied at 1,200 lb. gage, 725 deg. F.

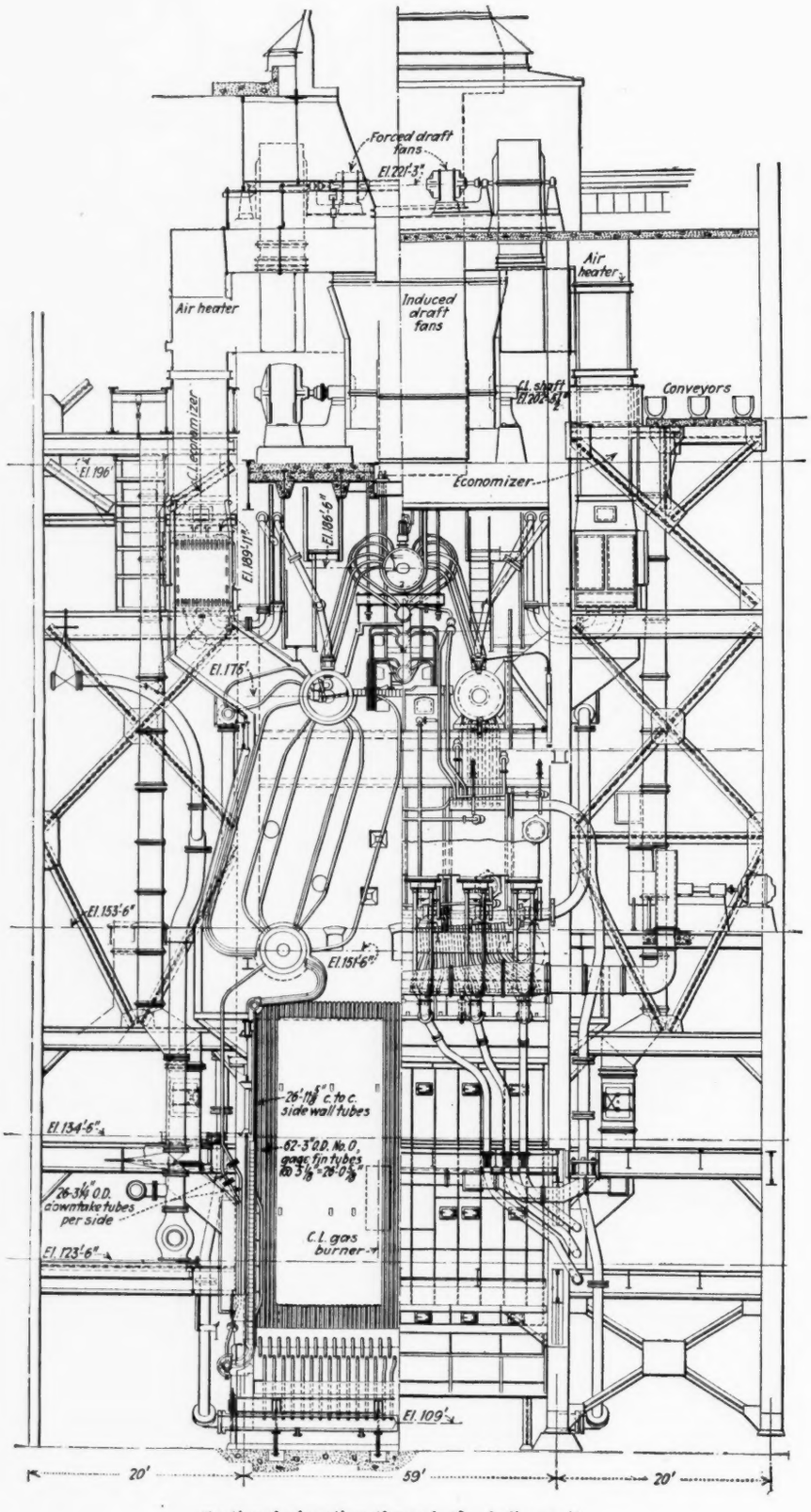
be had on both boilers together; whereas from the individual boiler drum switch, push-button control may be had on fuel or air independently or collectively on that particular boiler. Various positions of the drum switches will permit either boiler to be on full or partial automatic control, push-button control, or manual control independent of the method of operation of the other boiler. At each control drive, located at the point of operation, is a handwheel allowing manual control of the factor, should the electrical system for any reason become inoperative.

In addition to this combustion control system, automatic control equipment is applied to control boiler feed water, feed-water pumps, reheater condensate level, and drainage. All of these systems are designed to be flexible in their method of operation.

On the steel panelboard of each of the boiler units is mounted a boiler meter, two combination feed-water meters and boiler-drum water-level recorders, and two water-level indicators. Four recorders show the temperature of the feed water, flue gas and air at the inlet and outlet sides of the economizers and preheaters located at each side of the boiler. Two ten-compartment multipointer gages indicate various drafts and pressures. This equipment gives complete information as to the performance and operation of the boiler unit.

Space for Another Unit

Space is available in the turbine room for another unit of the same size should this additional capacity be needed. In the boiler room this would involve replacing two more of the older boilers, as was done for the present unit. With four 30,000-kw. units of Ford design available for service the station capacity now aggregates 230,000 kilowatts, which gives it the distinction of being the largest single industrial power plant.



Sectional elevation through the boiler unit

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Cost of Operating Diesel Power Plants

Salient points brought out in the report of the A.S.M.E. Diesel Power Cost Committee

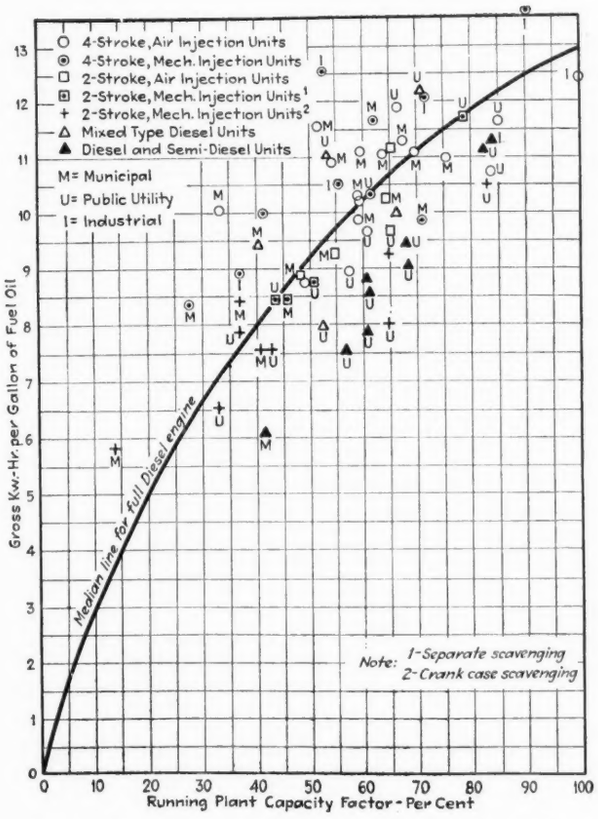
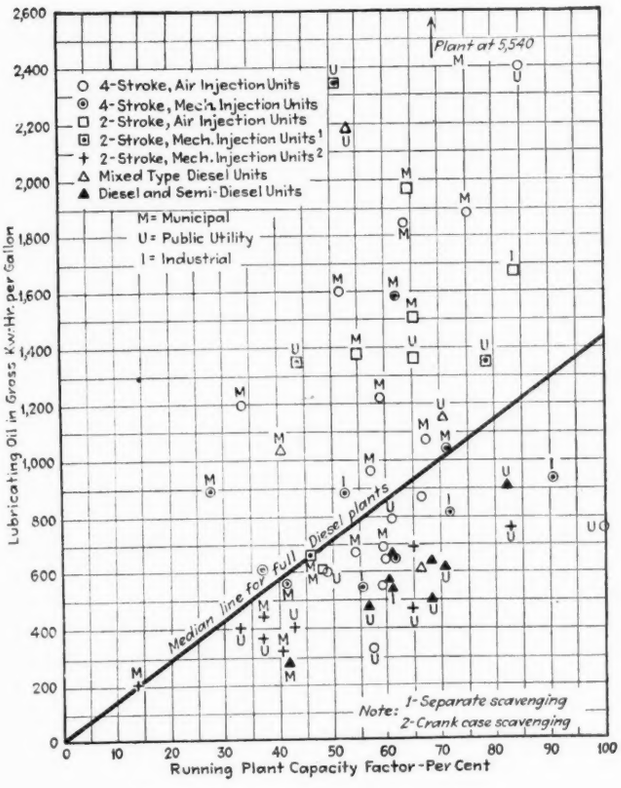

4-Stroke, Air Injection Units
4-Stroke, Mech. Injection Units
2-Stroke, Air Injection Units
2-Stroke, Mech. Injection Units[1]
2-Stroke, Mech. Injection Units[2]
Mixed Type Diesel Units
Diesel and Semi-Diesel Units
M= Municipal
U= Public Utility
I= Industrial
Median line for full Diesel engine
Note: 1-Separate scavenging
2-Crank case scavenging
Gross Kw-Hr per Gallon of Fuel Oil
Running Plant Capacity Factor - Per Cent

Fig. 1—Fuel oil consumption at various plant capacity factors


Plant at 5,540
4-Stroke, Air Injection Units
4-Stroke, Mech. Injection Units
2-Stroke, Air Injection Units
2-Stroke, Mech. Injection Units[1]
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Median line for Full Diesel plants
Note: 1-Separate scavenging
2-Crank case scavenging
Lubricating Oil in Gross Kw-Hr per Gallon
Running Plant Capacity Factor - Per Cent

Fig. 2—Lubricating oil consumption

WHAT is the probable cost of operating a diesel power plant? This has been a subject of discussion wherever sellers, buyers and users of oil engines and competitive forms of power have gathered together. Some optimistic advocates of the oil engine have laid claim to astonishingly high efficiencies, while others quite pessimistically have offered dire predictions of high fuel and lubricating oil charges and excessive maintenance costs.

Taking cognizance of the need for accurate impartial data on diesel power costs, the Oil and Gas Power Division of the A.S.M.E. three years ago created a committee to collect information from existing diesel plants in various parts of the country. The first report issued by this committee at once established the impartiality of the membership, as well as the value and accuracy of the compiled data. The report for 1930, which was presented at the National Oil and Gas Power Conference, held at the University of Wisconsin in June, is more valuable than its predecessors, since a larger number of plants were included. Furthermore, another year's records enabled the influence of age upon an engine's performance to be studied, although this will be of greater value when several years' reports have accumulated.

Over one thousand questionnaires were sent out, and of these complete replies were received from 81 plants containing 253 engines totaling 146,865 hp. In addition, there were thirteen plants which did not send in the data until too late to have the information included in the main report; the committee, however, prepared supplementary tables to accommodate these. The total plant capacity, 146,865 hp., covered in the 1930 report is gratifying when compared to the 68,775 hp. included in the 1929 report.

Aside from the value of the report, by reason of the data it contains, the questionnaire has induced many plants to establish cost-record systems. Surprisingly, it was not always the small plant that had inadequate records; plants of considerable capacity apparently were floundering along with little or no knowledge of the operating costs.

Fuel and Lubricating Oil Data

This year the committee summarized the tabulated figures on fuel and lubricating oil economy in graphical form in Figs. 1 and 2. In these charts the gross kilowatt-hours per gallon, using plant averages only, are plotted

against running plant-capacity factors. The following types of engines were covered:

Diesel four-stroke-cycle, air-injection.
Diesel four-stroke-cycle, mechanical-injection.
Diesel two-stroke-cycle, air-injection.
Diesel two-stroke-cycle, mechanical-injection, separate scavenging.
Diesel two-stroke-cycle, mechanical-injection, crank-case scavenging.
Mixed type full-diesel.
Mixed diesel and semi-diesel.

A median line was drawn on each chart, the number of points above the line being equal to the number below.

The fuel and lubricating oil costs presented this year included costs for handling oil from the cars to the tanks. It was the intention of the committee to have these handling charges included in the 1929 report also. However, some operators may not have included these expenses; this year they were all specifically asked to do so.

As has been stated, many of the plants reporting this year supplied data in 1930. This permitted a comparison of operating costs for two years, which is shown in the table. Examination of the several columns reveals that even the labor costs of many of the plants showed remarkable variation in the two years. While a few plants suffered an increase in labor costs per kilowatt-hour, in the main this item was decreased. The reason for this is not apparent in the committee's report, but wage reductions may have been a factor. The general reduction in fuel costs probably is attributable to the lower market price of fuel oil in 1930.

The fact that in almost all of the plants containing engines of various ages, the units installed after 1925 are employed to carry the main load. This indicates that these newer units are improvements over the older designs.

Examination of Figs. 1 and 2, covering the lubricating oil and fuel consumptions of the reporting plants, brings to light a somewhat unexpected and surprising condition. A prevailing assumption exists in engineering circles that municipal light plants are not operated as efficiently as are those of the public utilities. In spite of this most of the municipal plants covered in the report showed the better performance. One plant delivered 5,540 kw.-hr. for each gallon of lubricating oil used. Those who are familiar with the larger diesel plants will recognize this as the St. Petersburg (Fla.) municipal plant. In 1929 this plant's record was equally good.

The best results in fuel consumption are those of two industrial plants, both of which are equipped with mechanical-injection units.

When an attempt is made to compare plant investment costs one finds himself at sea. Naturally the large plants are expected to cost less per unit capacity than small plants. But this assumption does not always hold, for the largest plant reporting cost the most per horsepower capacity, and the lowest unit investment was in plants from 500 to 1,500 horsepower.

Space in this digest does not permit the inclusion of all the tabulations of the report. The complete report may be obtained from the American Society of Mechanical Engineers.

COMPARATIVE COSTS - 1929 REPORT AND 1930 REPORT

Plant Number	Total Installed B.H.P.		Total Net Output-K.W. Hrs.		Annual Plant Load Factor		Running Plant Capacity Factor		Plant Service Factor		Average Cost of Fuel Oil-Cents Per Gallon		Operating Costs Per Net K.W. Hr. - Mills														Plant Number
													Fuel Cost		Lubricating Oil Cost		Attendance & Superintendance Cost		Cost of Supplies & Misc. Including Water		Cost of Engine Repairs		Cost of All Other Plant Repairs		Total of All Supply, Repair & Misc. Costs		Total Production Cost		
	1929	1930	1929	1930	1929	1930	1929	1930	1929	1930	1929	1930	1929	1930	1929	1930	1929	1930	1929	1930	1929	1930	1929	1930	1929	1930	
43	11,540	11,540	22,591,027	26,221,176	45.4	46.1	6.99	70.4	48.1	57.8	4.25	4.37	3.82	3.95	0.69	0.53	0.60	0.94	-	0.21	-	0.67	-	0.05	1.04	0.93	6.14	6.35	43
46	6,900	9,250	24,909,500	27,444,480	69.4	60.7	83.3	83.6	76.3	67.2	4.92	3.62	4.48	3.35	0.19	0.23	0.83	0.61	0.32	0.19	1.33	0.95	0.22	0.25	1.87	1.39	7.38	5.58	46
91	3,450	5,250	7,585,725	8,167,025	46.6	53.7	52.0	53.1	72.8	52.4	3.90	4.09	3.72	3.95	0.48	0.29	1.18	1.06	0.16	0.16	0.22	0.33	0.07	0.04	0.45	0.53	5.82	5.83	91
92	2,500	4,900	6,662,389	10,027,739	44.1	56.8	71.6	65.0	61.6	61.1	2.15	2.09	2.20	2.25	0.55	0.33	1.24	0.92	0.17	0.26	1.85	0.26	0.12	0.06	2.14	0.58	6.13	4.08	92
52	3,330	4,580	5,722,032	7,257,703	31.1	33.6	65.3	75.2	45.2	45.4	5.58	5.70	5.38	5.30	0.55	0.33	3.83	2.83	0.88	0.74	0.74	0.56	0.40	0.48	2.02	1.78	11.77	10.29	52
45	4,250	4,250	7,442,350	6,908,500	36.8	34.9	72.5	69.5	43.6	42.4	5.23	5.29	5.04	5.18	0.09	0.09	1.65	1.77	0.06	0.04	-	1.01	-	0.10	0.92	1.15	7.70	8.20	45
2	3,450	--	No Reply To Inquiries		This	Year																							2
3	3,125	3,125	2,341,730	2,357,153	32.1	27.8	42.2	40.4	36.2	32.7	4.53	5.00	5.95	5.49	0.54	0.46	5.62	4.71	0.47	0.23	1.20	1.84	0.15	0.03	1.82	2.10	13.93	12.76	3
7	1,830	2,760	3,231,938	3,211,821	36.0	38.0	64.8	61.8	53.2	53.1	5.77	4.79	5.31	4.52	0.36	0.35	3.06	3.17	1.34	1.19	-	1.57	-	0.31	3.98	3.07	12.70	11.11	7
41	2,370	2,370	3,798,810	4,068,290	39.6	39.2	-	59.0	-	44.2	5.51	5.19	5.43	5.09	0.48	0.48	4.11	4.08	0.24	0.37	0.22	0.63	0.07	0.15	0.53	1.15	10.54	10.80	41
5	2,160	2,160	319,120	1,013,269	3.7	8.1	-	-	-	-	4.15	4.04	5.46	4.86	1.77	1.25	11.61	5.56	3.56	1.14	-	-	-	-	17.99	8.17	36.81	19.84	5
6	2,100	2,100	1,318,698	1,576,234	10.0	18.8	-	-	-	-	4.70	4.51	4.17	3.93	0.72	0.57	2.67	2.07	0.47	0.40	-	-	-	-	1.61	2.03	9.16	8.60	6
93	1,980	1,980	2,838,950	2,659,910	27.4	30.9	44.8	43.4	59.4	58.6	4.16	4.09	5.25	5.35	0.52	0.39	2.50	2.65	0.15	0.16	0.38	0.51	0.09	0.02	0.62	0.69	8.88	9.08	93
18	1,650	1,650	2,351,123	2,406,690	26.4	27.2	-	-	-	-	4.71	4.49	4.52	4.51	0.41	0.61	2.58	2.08	0.38	0.21	-	-	-	-	2.30	4.80	9.81	12.00	18
10	1,500	--	No Reply To Inquiries		This	Year																							10
11	1,350	--	No Reply To Inquiries		This	Year																							11
13	1,225	1,225	1,169,971	1,131,661	33.8	32.7	55.9	5.92	34.1	31.2	6.00	5.69	7.44	6.60	0.57	0.65	4.74	4.88	1.00	0.54	0.89	0.39	0.77	0.08	2.66	1.01	15.41	13.14	13
17	1,200	1,200	1,611,876	2,148,910	20.7	27.5	-	-	-	-	4.52	4.45	4.69	4.23	0.53	0.50	2.64	2.06	0.67	0.36	-	-	-	-	2.11	1.96	9.96	8.75	17
94	1,200	1,200	2,982,340	3,315,550	39.6	39.9	67.0	66.4	64.9	71.1	3.17	3.12	2.83	2.76	0.55	0.59	1.93	1.69	0.36	0.30	0.25	0.51	0.19	0.05	0.80	0.86	6.11	5.90	94
68	1,160	--	No Reply To Inquiries		This	Year																							68
95	1,120	1,120	1,675,810	1,408,900	26.0	23.3	48.0	50.7	57.8	45.4	3.23	3.12	3.76	3.63	0.32	0.21	3.60	3.54	0.32	0.38	0.36	0.68	0.15	0.02	0.83	1.08	8.51	8.65	95
96	1,100	1,100	1,133,027	1,215,181	17.0	24.3	49.1	61.5	37.7	32.2	3.61	3.56	4.30	3.54	0.99	0.66	3.87	4.26	0.54	0.43	4.39	0.78	0.19	0.21	5.12	1.42	14.26	9.88	96
97	1,020	1,020	2,027,967	1,816,136	39.9	38.9	51.1	57.4	57.7	53.9	3.18	3.36	3.48	3.87	1.51	1.61	3.01	3.98	0.30	0.19	1.56	0.26	0.10	0.08	1.96	0.53	9.96	9.99	97
98	1,000	900	1,677,817	1,774,521	35.1	39.9	63.2	64.5	47.9	56.7	5.57	4.73	7.31	6.37	1.05	0.90	3.05	3.28	0.45	0.60	1.68	1.00	0.21	0.31	2.34	1.91	13.75	12.46	98
100	740	740	1,247,150	1,459,540	49.7	35.1	59.9	60.9	50.2	58.1	3.36	3.50	4.14	4.32	0.73	0.68	4.69	3.70	0.41	0.47	0.37	0.82	0.20	0.06	0.98	1.35	10.53	10.05	100
67	720	720	1,163,600	1,098,900	64.0	58.4	79.1	82.9	33.7	30.3	5.94	4.97	6.03	4.73	0.55	0.71	1.60	1.70	0.21	0.23	0.04	1.03	0	0.02	0.25	1.28	8.43	8.42	67
19	700	700	603,260	710,280	29.8	34.9	-	-	-	-	4.50	4.13	6.32	5.72	1.40	1.26	5.40	4.96	1.07	1.07	-	-	-	-	2.24	4.06	15.36	15.99	19
106	600	600	750,419	1,435,434	17.5	35.6	-	-	-	-	4.66	4.49	4.75	4.18	0.66	0.27	2.66	3.09	0.61	0.65	-	-	-	-	2.62	2.52	10.69	10.06	106
103	390	580	772,985	995,145	40.8	38.0	53.3	60.2	67.8	61.2	4.63	4.20	6.04	5.43	0.99	0.93	5.82	4.60	0.56	0.49	0.86	1.73	0.28	0.43	1.69	2.65	14.54	13.61	103
102	480	580	577,920	591,620	24.7	27.4	39.8	42.7	58.1	55.1	3.41	3.25	5.22	4.78	1.61	1.36	8.51	8.32	0.57	0.34	0.56	0.28	0.30	0.35	1.43	0.97	16.77	15.43	102
101	540	540	866,871	768,521	36.5	49.1	53.7	60.5	40.3	40.6	3.56	3.79	4.35	4.56	1.43	0.90	6.39	5.62	0.83	0.35	2.67	0.74	0.57	0.03	4.07	1.12	16.74	12.20	101
104	415	--	Not Operated In 1930;		Load	Served By High Tension System																							104
99	600	400	1,356,589	385,005	31.7	-	72.9	84.9	49.9	19.4	3.09	3.18	2.68	2.81	0.41	0.24	3.04	3.12	0.42	0.63	0.60	0.61	0.21	0.02	1.23	1.26	7.36	7.43	99
24	400	--	No Time To Work Up Information To Fill Out Questionnaire																										24
105	370	370	272,136	372,330	33.1	33.4	51.7	56.5	35.9	35.7	3.20	3.14	5.97	4.77	3.69	1.09	14.60	11.00	1.76	0.97	6.59	0.44	0.90	0.17	9.25	1.58	33.51	18.44	105
26	330	--	Not Operated In 1930;		Using Purchased Power																								26

Fig. 3—Comparative operating costs of 1929 and 1930

Specifications for Selecting Pumping Equipment

By R. H. PARRISH
Industrial Engineer, Mission, Texas

IRRIGATION pumping can be classified into four groups as regards pump and motor requirements:

1. River pumping where water is pumped for sale to numerous customers owning land along canals, laterals and sublaterals leading from central pumping plant on the river.

2. River pumping where smaller capacity pumps are used to furnish water through canals directly to customers whose land lies adjacent to the pumpsite.

3. Pumping water from wells with vertical turbine, centrifugal, cylinder, or air-lift type pumps.

4. Relift pumping where low-lift pumps are used to elevate water from one canal elevation to a higher one.

No pump should be purchased without first thoroughly considering the operating characteristics as applied to the head conditions of the particular location. Stock pumps are apt to be dangerous to apply, even though desirable for other services, for reason that the head design is not suitable for every particular head condition. By all means an engineering check-off, such as the following, should be made prior to the purchase and installation of pumps and motors:

1. What efficiency, gallons per minute, and input horsepower will the pump show at the mean total operating head? The input horsepower at this particular head will determine the kilowatt-hour consumptions per acre-foot. The pump manufacturer should definitely guarantee this rate of consumption.

2. What effiicency, gallons per minute, and input horsepower will the pump show at the minimum operating head? This will determine the size motor to use, as in most pumps the lowest head means the greatest horsepower. Again the kilowatt-hour per acre-foot for this head should be guaranteed.

3. What efficiency, gallons per minute, and input horsepower will the pump show at the maximum operating head? This is very important, for the pump may not discharge at or near this head, due to drop in river level. The kilowatt-hour per acre-foot should be specified for this head.

4. Ability of the motor to start the pump is important. Many installations, for this reason, would not prime without tedious maneuvering, because the motor could not develop sufficient pull-in torque to give the pump a full prime. This can be safeguarded against by specifying a 100 per cent pull-in torque synchronous motor, a slip-ring motor, or a heavy-starting-duty type squirrel-cage motor. Second, by specifying proper discharge valves, either hand- or motor-operated.

5. Wiring specifications should state whether the bidder is to do the wiring. Often misunderstanding arises as a result of the customer's believing that the bidder meant to do the wiring and furnish all the necessary equipment that goes with it, such as line switches, wire, poles, etc., whereas it was not so stated in the bid. In irrigation pump houses moisture conditions are generally more severe than for other services and wiring specifications should be made accordingly.

6. Check valves are important. When the unit is running full speed in one direction and power to the motor fails, the head conditions are usually such that the pump stops suddenly and reverses, causing dangerous strain on the shaft, bearings and pump housing. Check valves should be supplemented by a gate valve.

7. Since the main consideration is always power cost, the bidder should be held to certain guarantees, such as: "Bidder submits pump-performance curve herewith marked 'Exibit One' and guarantees that the efficiency at the various heads as indicated will be attained after pump is installed and upon test by competent engineers, by rules of The Hydraulic Society. Also in the event such test shows these efficiencies are not maintained bidder will be penalized an amount equivalent to the difference in power cost over a five-year operating period. This amount is agreed to be $—— per each 1 per cent the actual efficiency is below that guaranteed. Likewise, should the test show the actual efficiency above that guaranteed, customer agrees to pay bidder a bonus at the same rate, this amount is agreed to be $—— per each 1 per cent the efficiency is about that guaranteed."

▼

Advantages of the Flooded-Ammonia Evaporator

By R. F. SORRELLS

IT SEEMS to be a universally accepted fact that the flooded-ammonia evaporator system, for use in ice tanks and ice vaults is superior to the hand-valve-controlled expansion system. The average operator usually explains this superiority with the statement that it permits a more even control of the ammonia supply in the evaporator. Such an explanation is true, but it is believed that further discussion is in order to clarify the difference between the two systems.

It is understood that when liquid ammonia is brought to an expansion valve at a given temperature and expanded to a lower pressure and temperature a definite amount of the liquor is evaporated in cooling the remaining liquor to the saturation temperature of the ammonia in the evaporator. The amount of the liquor evaporated will, of course, vary with the temperature and pressure conditions of the ammonia before and after expansion.

The table shows the per cent of liquor evaporated for various evaporator pressures and temperatures, assuming 86 deg. F. as the initial temperature of the liquor. Higher temperature of the liquor before entering the expansion valve will increase this percentage of evapora-

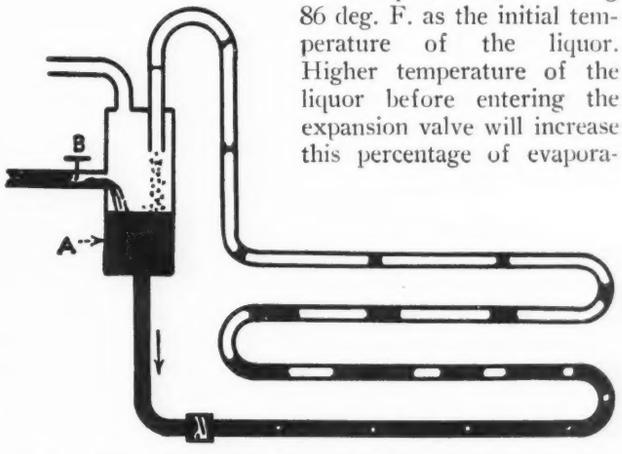


Fig. 1—Flooded-Ammonia Evaporator Coil With Accumulator

tion, while lower initial temperatures will tend to lower it.

Pressure After Expansion, Lb. per Sq.In. Gage	Temperature After Expansion Deg. F.	Per Cent Liquor Evaporated at Expansion Valve
0	−28.0	21.30
5	−17.2	19.65
10	− 8.4	18.21
15	− 1.0	17.01
20	5.5	15.90
25	11.3	14.87
30	16.6	13.98

It is readily seen that approximately 14 to 21 per cent of the liquor going through the expansion valve is evaporated in cooling the remaining liquor, when the liquor comes to the expansion valve at 86 deg. Of course, this evaporation does no refrigeration work that can be credited to the evaporator coils. Also, from 14 to 21 per cent of all of the gas coming from the evaporator is formed immediately after passing through the expansion valve.

Considering Fig. 1, we find the liquid ammonia entering accumulator *A* through valve *B*. Valve *B* may be hand-operated or float-controlled from the level of the liquor in the accumulator. The float-controlled valve is gaining preference.

As soon as the liquor enters the lower pressure of the evaporator this 14 to 21 per cent of ammonia is evaporated and cools the remaining liquor to the evaporator temperature. The vapor forming at this point is immediately carried away through the suction to the machine and never enters the evaporator. This, of course, leaves practically 100 per cent liquor entering the evaporator. In this way full use is made of all of the cooling surface of the coils.

Now consider the coil with the hand-controlled expansion valve shown in Fig. 2. Here, as in the previous case,

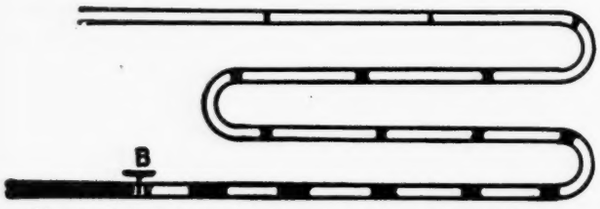


Fig. 2—Ammonia Evaporator Coil With Hand-Controlled Expansion Valve

14 to 21 per cent of the liquid ammonia is evaporated to cool the remaining liquor. In this case, however, the vapor formed must pass through the entire set of coils before leaving the evaporator. This gas does no refrigeration work. It cuts the actual rate of transfer per unit of surface between the air of the vault or the brine and the liquor in the coils an amount corresponding to the per cent of the liquor evaporated during expansion.

This formation of gases immediately after passing through the expansion valve and their passage up through the evaporator coils means that a greater velocity of liquid and vapor must be maintained to pass sufficient liquor through the coils to produce the desired refrigerating effect.

The increased velocity will naturally call for a greater difference in pressure across the evaporator, which, in turn, will call for a lower suction pressure from the evaporator. Of course, this lower suction pressure will mean less efficiency for the ammonia compressor and higher power costs per ton of ice or ton of refrigeration.

There are also other reasons for the superiority of the flooded-ammonia system, but the foregoing alone should be sufficient to affect any choice between the two systems.

Cutting In Oil Cooler Shuts Down Turbine

By GEORGE ROSENTRETER

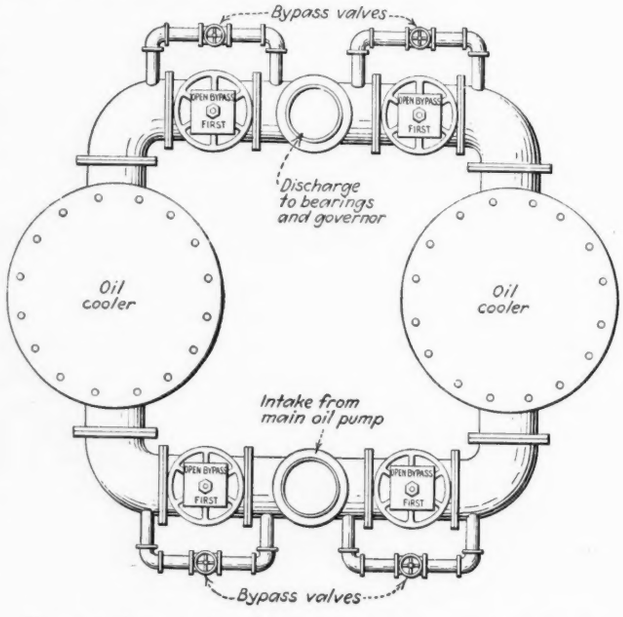
NOT LONG AGO one of our operators, in changing over oil coolers, opened the valve on the cooler about to be placed in operation too quickly. The sudden inrush of oil into the empty cooler caused a considerable drop in oil pressure.

A valve ahead of the low-pressure turbine, which receives reheated steam from the high-pressure turbine, is held open by oil pressure. The drop in oil pressure was sufficient to allow this valve to close. The turbine lost its load and the boiler safety valves popped.

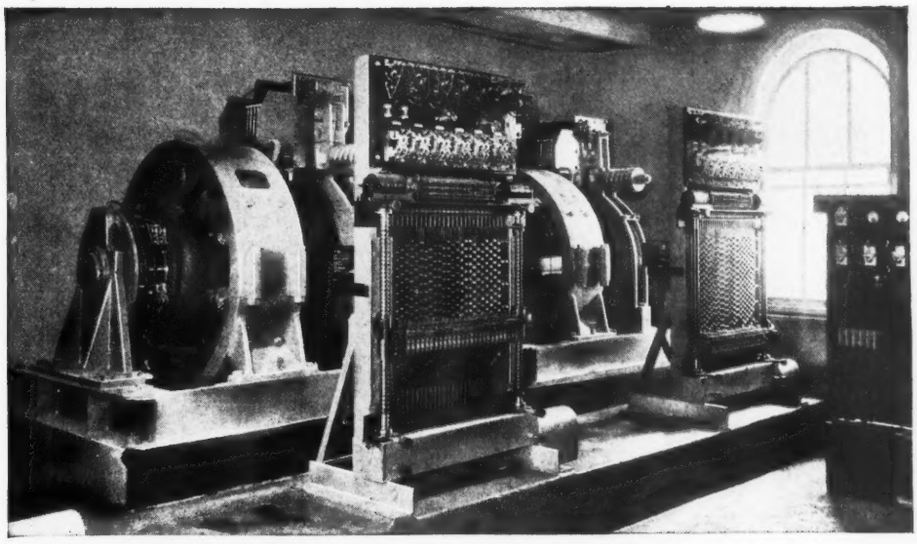
This may happen in any plant having two oil coolers and a throttle valve held open by oil pressure. To prevent, so far as possible, such an occurrence in the future the arrangement shown in the plan view of the oil coolers is suggested.

As close as conveniently possible, put a bypass around the inlet and outlet valve of each oil cooler, and have the valve in the bypass as close as possible to the main valves. Make four plates of heavy galvanized iron or brass, drill a hole through the middle of sufficient size to fit the top of the valve spindle and paint each one with a good grade of durable black paint. Make them large enough to fit over the wheel of the oil valves on the coolers, as illustrated. Print in white letters with durable paint "Open bypass first" on one side. Take the nuts off the valve stems and place one plate over each wheel.

When a man is about to open a valve to change coolers he will see the caution plate, and the bypass valve will also be seen easily. The bypass should be large enough to fill the cooler in a short time without robbing anything else of oil. The oil will then quickly but gradually fill the oil cooler, instead of a great rush of oil that would occur if the large valve were opened. Whether it is left open or closed after the large valve is opened makes no difference, as all the oil goes through the cooler. If the bypass is left open and the cooler taken out of service it will not do any harm.



Plan showing warning plates and bypass around oil valves



These high-speed passenger elevators in a modern office building are controlled by pre-register signal systems

Pre-Register Signal System Stops Elevators Automatically

A system in which signals to stop are registered in advance by buttons in the car and from the landings. At the proper point in the car's travel the operator is notified by a signal to center the car switch so that the car will stop automatically at the landing for which the signal was given

ELEVATORS of the automatic-landing, car-switch type, traveling at high speed and equipped with solid-door cars, require a more complete signal system than the ordinary car-switch-controlled machines. With the latter, the waiting passengers on the landings signal to the car operator by pressing a button that indicates on an annunciator the floor number and the direction in which the passenger wishes to go. On another system a flashlight in the car signals the operator, when approaching a floor, where passengers are waiting to go in the direction of car travel.

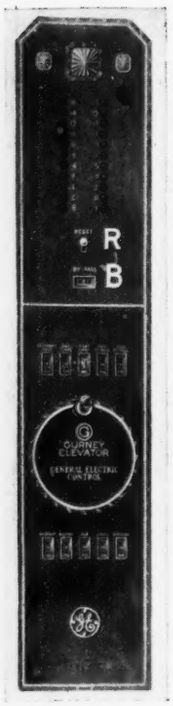
These systems function satisfactorily where the car has open-grille gates and travels at moderate speeds. As the speed of the car increases it becomes more difficult for the operator to read the floor numbers and to judge the stopping distance. This difficulty may cause a large number of false stops to be made or the car may be prematurely slowed down before making a stop, causing a reduction in the service rendered by the elevator. Where cars with solid doors are used they must be stopped at the floors automatically, as the operator cannot see the landings. On car-switch-controlled cars in this service the signal system must be so designed that it will indicate to the operator when to center the car switch, after which the car stops level with the floor automatically.

A pre-registering signal system gives the operator a signal to center the car switch as the car enters a stopping zone at full speed. Auxiliary signals are given to the operator when the car is at the first of two successive floors at which stops are to be made. The system may also be used to slow down the elevator automatically from the registered stop signals if desired.

A pre-registering signal system that accomplishes these requirements has bene developed by the Elevator Supplies Company. With this system there are the usual up and down signal buttons at the landings. There are signal lanterns over each hoistway door to indicate to the waiting passengers which cars are approaching the floors and the direction in which they are going. This arrangement is the same as is frequently used with elevators having the conventional type of car-switch control.

In each car above the car switch is a panel on which there is a button for each floor, as shown in Fig. 1. The operator presses the buttons corresponding to the floors called by the passengers when entering the car, When a button is pressed it is held in the closed position, indicating to the operator where stops are to be made. The closed button also completes a circuit to a selector in the machine room, and as the car travels up or down the hoistway a contact is made on the selector that flashes a signal light for the operator to center the car switch. This light is in the center at the top of the panel Fig. 1.

With this particular type of elevator control the signal light is an added precaution, since the operator does not have to depend on it to know when the car switch is to



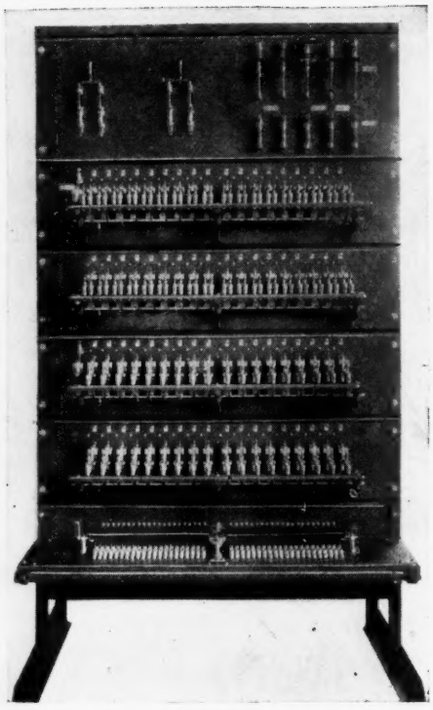


Fig. 1 (Left)—The bank of push buttons above the car switch is for the pre-register signal system
Fig. 2 (Right)—Master floor-relay control panel on which there are two mercury-contact relays for each intermediate floor and one for each terminal landing

be centered. The slow down is initiated by the registered signal, after which the operator centers the car switch. If the operator did not notice the car slowing down the signal light's flashing would show that the car switch should be centered to make a stop.

The car and hoistway door control contacts are on the car switch, so that when the operator moves the switch to a start position the doors close and the car starts and accelerates to full speed. With one type of control, when the car enters a stopping zone as established by a button being pressed in the car or at a landing the car slows down, after which the operator centers the car switch. The car then stops level with the floor for which the signal was given, and the car and landing doors open automatically. When registered stop signals occur consecutively, requiring stops at adjacent floors, or at two-floor intervals, the car does not attain full rated speed, but automatically slows down, and the warning signal is given to the operator in the same manner as when making a stop from full speed.

When the signals are registered in the car operator's panel the buttons, being of the mechanically locked type, remain in the closed position until the car approaches a terminal landing, when they are released automatically. Car-signal panels contain one button for each floor served, the same button being used for either direction of travel. If it is desired to reverse the car between terminal landings, the push button can be manually reset by the button *R*. Should the operator be unable to take on additional waiting passengers, the floor calls may be bypassed by switch *B*. Placing this switch in the bypass position will transfer the registered passenger signals to the next approaching car, but will not affect the registered stop signals on the car operator's panel.

At the top of the panel the two small lights are for the automatic dispatching system. One of the lights flashes when it is time for the operator to leave the first floor and the other flashes when the car should leave the top landing. The automatic dispatching system not only relieves the dispatcher of signalling the operators when to leave the first floor but it also insures that they will be signalled at the proper time at both terminal landings. This assists the operators to run closer to schedule than can be done by manual dispatching.

The small switches just above and below the car switch are part of the elevator control system and for the lights and fan in the car and are not a part of the signal system.

On another system of elevator control operating with pre-register signals two signal lights are used, usually of different color, to distinguish between high-speed two-floor and one-floor stop signals. With this control, when a car running at high speed enters the zone of a registered stop signal a contact made on the signal selector gives a visible red and an audible signal to the operator to return the car-switch handle to the off position, after which the car enters the stopping zone, is slowed down and stops automatically at the floor.

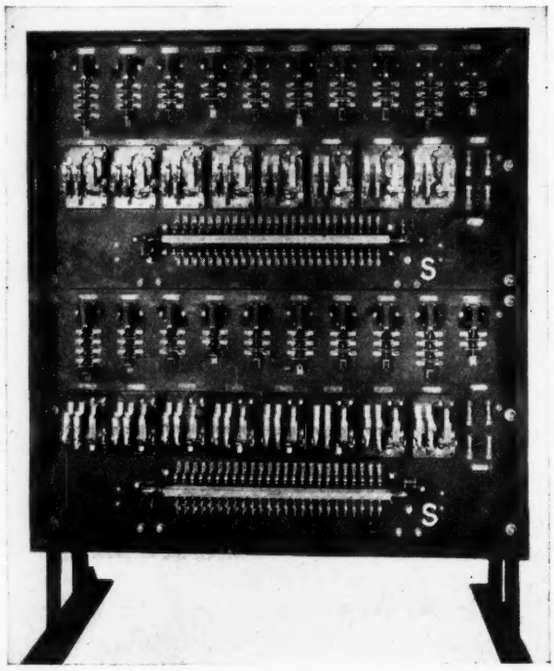


Fig. 3—This panel, which is for two cars in a group, contains the necessary relays for the proper functioning of the car operator's flashlight, floor lanterns and reset circuits

When stop signals occur two floors in advance of the floor at which a stop is made the operator's red signal will flash. To make the proper stop the car switch is centered after the car has traveled several feet. When registered calls occur consecutively, requiring stopping at adjacent floors, the operator receives a visible green signal when the car stops, indicating that a stop is to be made at the next floor. To make an adjacent floor stop the operator centers the car switch immediately after starting.

In the control room there are selector commutators, relay panels and other equipment essential to the signal and control system. The commutators for the floor stops, the floor lanterns, night annunciator, car-position indicator and other operations are assembled in a single unit, Figs. 4 and 5. Vertical commutators of the straightline double-screw type are used, except when the car speed is slow and the segment requirements are such that a standard friction-reversing commutator can be

used. The commutator is driven from the elevator's secondary sheave by a chain and sprockets. Stop nuts are assembled and locked on the screws and a friction stud is used on the drive shaft, so that the position of the brushes on the commutator will be corrected at each end of travel if necessary. The traveling nuts are sufficiently long to furnish a rigid guide for the brush carriage. Small pressed-steel "H" sections form the supports for the segments, which are inserted between and insulated from them. This arrangement of the "H" bars allows any desired assembly of the segments. By loosening the holding nut on a segment it may be readily adjusted to any position.

The brushes that pass over the segments during travel are of the roller-contact type and are adjustable both vertically and horizontally. Connections are taken from the brushes by flexible rubber-covered traveling cable to a stationary terminal box at the rear of the commutator, Fig. 5.

Commutators of the straight-line type on which the brushes pass over the same segments on the up and the down travel require a double-throw switch to open or to close certain circuits so that the signals for a given direction only are flashed when the car travels in that direction. This switch is shown at *S* on the control panel, Fig. 3, and is of the straight-line type. It is operated by two solenoids on the rear of the panel, one at each end of the switch. When one coil is energized the switch is thrown to one position, and energizing the other coil throws the switch to the opposite position. This switch changes its position automatically at the terminal landings when the car switch is thrown from the direction of travel to the terminal, thus insuring operation of the reverse switch to the proper position before the car starts. The control panel, Fig. 3, which is for two cars in a group, contains the necessary relays for the proper functioning of the car operator's flashlight, floor lanterns and reset circuits.

On the master floor-relay control panel, Fig. 2, there are two relays for each intermediate floor and one for each terminal landing. Each relay unit consists of two coils with an operating armature so arranged that when the release coil is energized the contacts drop and make the circuit in mercury. These contacts remain closed until the reset coil is energized, when they are pulled out of the mercury and the armature is latched in the open position. The release or signal-setting coils are connected directly to the landing push buttons. The signal-reset coils are connected to the corresponding reset segments on the commutator, which are cross-connected from commutator to commutator in the standard manner so that the first car to answer the call will reset the signal. This provides a full-selective feature necessary for this class of signal system. When signal installations have either telltale annunciator or night-service annuciators two independent contacts are mounted on each relay unit, one for 110-volt lamp circuits and the other for low-voltage lamp circuits.

By using the selective system false stops are eliminated. With high-speed elevators considerable time is lost when a car receives a signal, slows down, stops and the doors open, only for the operator to find out that another car has received the same signal and picked up the passengers. By preventing these false stops elevator schedules can be improved, which means more miles per car in a given time and a greater passenger-carrying capacity, besides a reduction in power consumption per car-mile.

This system of pre-registered signals makes accurate stopping of car-switched-controlled elevators a simple operation of centering the car switch. When the operation of landing and car doors is tied into the control system the operator is left practically free to attend to the needs of the passengers. All of which is reflected in better elevator service and more satisfied tenants in the building.

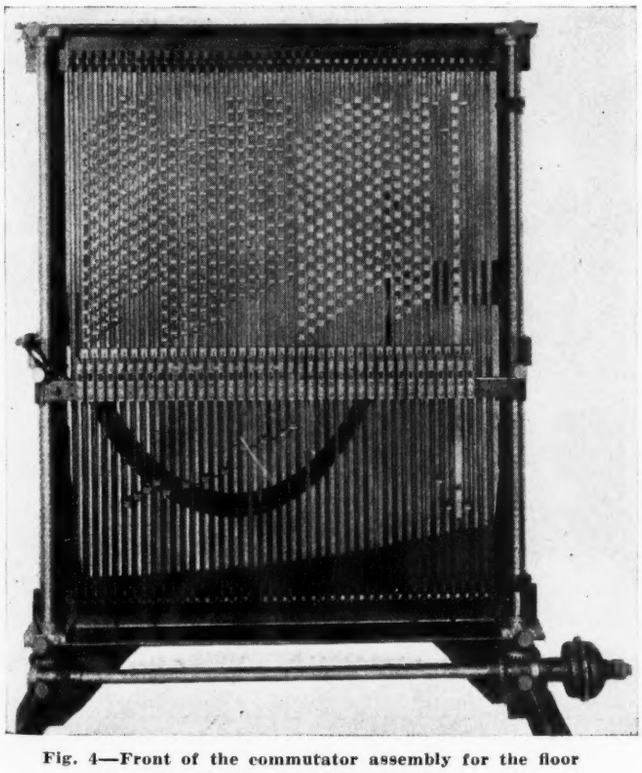


Fig. 4—Front of the commutator assembly for the floor stops, floor lanterns, night annunciator, car's position indicator and other operations

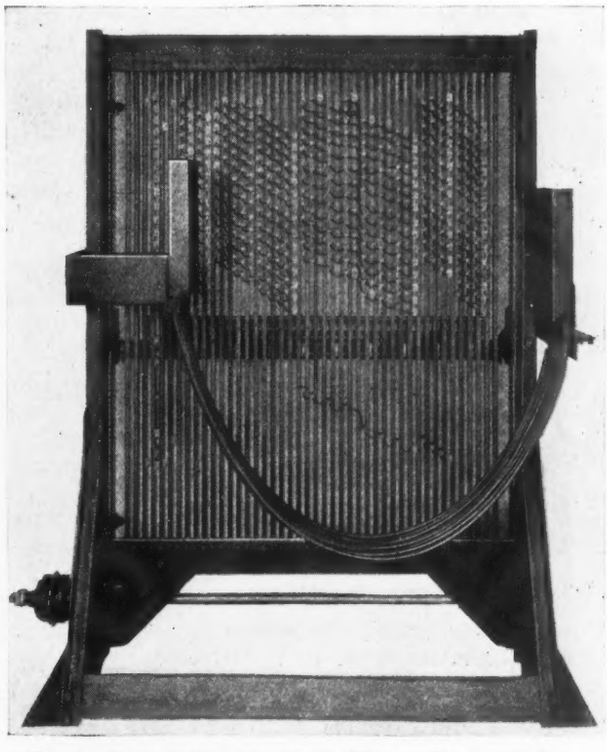


Fig. 5—Rear of the commutator, Fig. 4. The connection between the moving brushes and the stationary wiring is made by flexible travelling cable

Economical Operation Impossible Without Records

Experience in power department of famous glass plant shows that the keeping of records and their careful analysis is a certain road to profits

THIS is an article ostensibly on the power plant of the Corning (N. Y.) Glass Works, but more fundamentally on the economic necessity of keeping and using power records. At the suggestion of Alfred Vaksdal, plant engineer of the Corning Glass Works, that institution—famous for Pyrex, for electric lamp bulbs and for numerous beautiful and useful articles of glass—will be used as a concrete example of the value of records.

The Corning plant has always generated all of its power services, starting 62 years ago with a rope drive. The present services are alternating current, direct current, compressed air and pumped water.

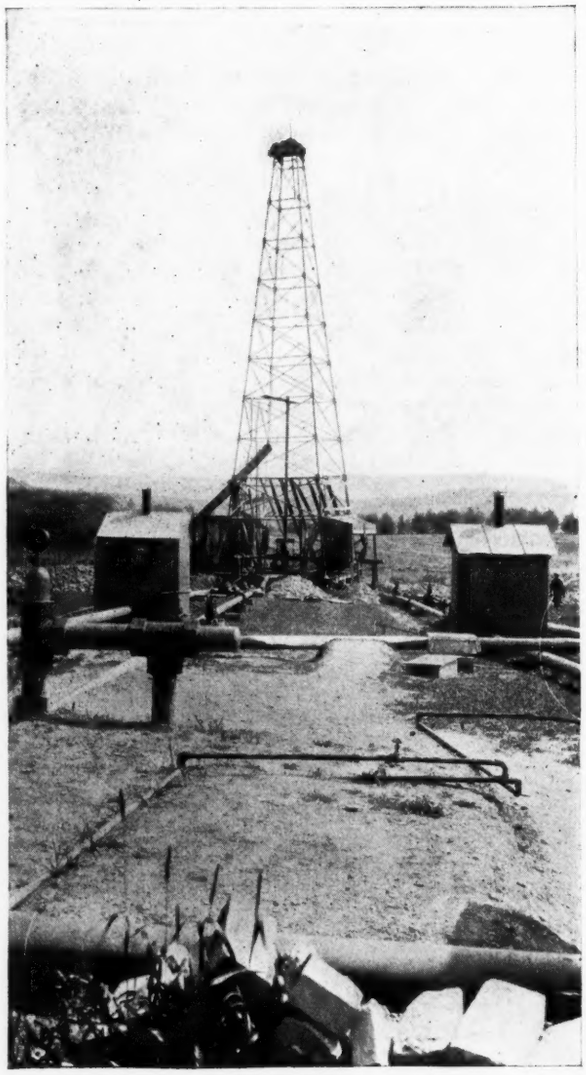
A Bit of History

Before discussing present records and operation of this plant, a bit of history will be in order and of interest. Back in 1921 the demand for steam and electricity had crept up on the apparent capacity of the plant to the point where there was an urgent call for new equipment. A recommendation was made which if carried out would have involved the expenditure of $300,000. Further analysis of the situation revealed the fact that this expenditure was unnecessary and would be so for years to come if an expenditure of $20,000 were made to hook up and operate the existing equipment properly.

A 500-kw. non-condensing unit, standing idle as a reserve, was put in operation. Its exhaust replaced live steam in the heating system. In summer the excess exhaust was absorbed by a mixed-flow turbine.

One of the branch plants, 1,300 ft. from the main plant, discontinued its boilers. Its steam-driven air compressor was supplied from the main plant through a pipe line and exhausted, in turn, to the local heating system. With these and a few corrections in the system, together with better operation of the boilers, it was possible to shut down one or more boilers in the main plant and thereby insure a spare unit. Thus the suggestion expenditure of $300,000 was postponed for many years.

The boiler efficiency was increased from 64 to 78 per cent. By increased use of exhaust steam the net steam consumption for electricity was decreased from 30 lb. per kilowatt-hour to 14 lb. The net steam consumption for compressed air was decreased from 55 lb. per 1,000 cu.ft. to 40 pounds.



One of many large natural-gas wells serving the Corning district

It is decidedly interesting to note that from 1922 to 1925 the compressed-air demand was doubled, the electric load tripled and the radiation in buildings increased 60 per cent; and that in the face of all this the

TABLE I—POWER REPORT

	Jan.	June
Coal consumed, lb.	2,952,450	2,155,115
Total water fed to boilers, lb.	32,695,308	24,338,632
Water blown down, lb.	952,290	708,632
Steam, lb.:		
Generated	31,743,018	23,629,934
Auxiliaries	3,656,076	3,102,100
Net, delivered	28,086,942	20,527,830
Generated per lb. of coal	10.75	10.96
A.-C. generation	9,007,000	12,400,000
D.-C. generation	47,372	141,430
Compressed air	1,316,370	2,400,000
Steuben	1,985,200	924,400
Heating	12,000,000	2,000,000
Factory	3,731,000	2,662,000
Pot and clay plant	.....	21,000
A. C. Current, Kw.-Hr:		
Generated	519,610	479,890
Purchased	1,400	None
Consumed	521,010	479,890
Consumed by power house	16,000	14,000
Delivered	505,010	465,890
To Steuben	11,800	10,400
To pot and clay plant	.....	4,000
For d.c.	63,400	47,600
For compressed air	116,390	115,860
For water	23,800	23,000
Compressed Air, Cu.Ft.:		
Compressed	13,335,581	119,832,802
To Steuben	176,000	764,000
To pot and clay plant	.....	55,000
Water, Gal.:		
Pumped	22,500,000	21,600,000
Purchased	7,926,631	7,862,078
Delivered	30,426,631	29,462,078
D. C. generated, Kw.-Hr.	49,408	37,260

total yearly cost of the power services was reduced by $35,000. About half of this saving came from improved efficiency and better hook-ups. The remainder came from the elimination of frequent rebuilding of furnace walls. Before the changeover it was customary to rebuild one wall every week-end.

It is to be noted that this condition was revealed only because the issue was forced by the apparent fact that the plant had reached the limit of its capacity. Even then the first recommendation was greatly in error. Only a close analysis revealed the proper course. If a record system, such as has been used since, had then been used, a substantial portion of this $35,000 yearly saving would have been obtained for many years before.

It is Mr. Vaksdal's conviction that the primary concern of a power executive is the proper keeping and interpretation of records. In no other way, he believes, can numerous wastes in the production, transmission and utilization of the power services be discovered. To prove the point he tells several stories of large wastes existing in consuming departments without the knowledge of the department heads.

The system now used is too extensive to review in full here. Each day the power engineer submits to Mr. Vaksdal a log sheet completely filled in. Required hourly readings include windbox, firebox and uptake draft of each boiler, the speeds of four different compressors, temperature of boiler-feed water, five condenser readings (inlet and outlet water temperatures and condensate temperature, vacuum and barometer), wattmeter and ammeter readings on the 750-kw. and 500-kw. turbines, the alternating-current voltage and power factor, the direct-current voltage and the amperage on the three direct-current machines (two motor-generator sets and one engine unit). Alternating-current and direct-current loads are also plotted on the report sheet.

With all machines in operation, these hourly entries total 768 daily and obviously require considerable work by the watch engineers. Mr. Vaksdal feels that the watch engineers should be in constant touch with the operation of all equipment and that the mandatory keeping of hourly records is the only way to insure this. Boiler operation, in particular, is likely to fall off if drafts are not closely watched.

Daily readings required include eight steam-flow meters, eight kilowatt-hour meters, four air meters, two water meters, condensate meter and ejector meter. Other readings cover the zeolite water-softening system, feed-water meter and lubricating oil consumption. An operating summary includes total coal, water evaporated, evaporation per pound of coal, pounds of coal per retort, pounds of ash, per cent of ash and water to softeners.

Reproduced herewith (first column of Table I) is the power report of January, 1931, as sent to the cost department. Note that the report contains physical quantities only—no costs. The latter are computed by the cost department according to rules and data supplied by the plant engineering department.

In Table I account has already been taken of the double use of steam in the case of turbines, compressors, etc., exhausting to the heating system. Heating is charged with the live-steam equivalent of the exhaust so used and corresponding credits are made to the exhausting units. As a result the kilowatt-hour and compressed-air costs are much lower in the winter.

TABLE II—POWER HOUSE REPORT
Submitted by Cost Department

	January, 1931	June, 1931	Aver., Yr. to Date
Coal, tons	2,952,450	2,155,115	2,467,819
Cost per ton	4.30	4.1625	4.26
Steam generated, lb.	23,743,018	23,629,934	26,580,196
Steam per lb., coal	10.75	10.96	10.77
Cost per M lb. steam generated excl. overhead	$0.2718	$0.2637	$0.2769
Cost per M lb. steam generated	$0.3312	$0.3485	$0.3533
To factory, lb.	3,731,000	2,662,000	3,210,000
Cost per M lb steam delivered	$0.3344	$0.3663	$0.3736
Steam for heating	12,000,000	2,000,000	7,166,667
A.C. generated, Kw.-Hr.	519,610	479,890	448,006
Cost per Kw.-Hr.:			
Generated, excl. overhead	$0.0068	$0.0115	$0.0095
Generated	$0.0080	$0.0129	$0.0110
Delivered	$0.0081	$0.0134	$0.0112
D.C. generated, Kw.-Hr.	49,408	37,260	40,765
Cost per Kw.-Hr.:			
Generated, excl. overhead	$0.0124	$0.0223	$0.0186
Generated	$0.0139	$0.0245	$0.0205
Delivered	$0.0140	$0.0297	$0.0223
Air generated, cu.ft.	133,335,581	119,832,802	110,795,097
Cost per M Ft.:			
Compressed, excl. overhead	$0.0118	$0.0228	$0.0158
Compressed	$0.0124	$0.0235	$0.0165
Delivered	$0.0126	$0.0241	$0.0176
Water purchased, gal.	7,926,631	7,862,078	6,675,626
Water pumped, gal.	22,500,000	21,600,000	21,750,000
Cost per M gal.	$0.0377	$0.0324	$0.0376

Note that in January 12,000,000 lb. of steam was charged to heating, that the delivered unit cost of electricity was $0.0081 per kilowatt-hour (alternating current) and that of compressed air $0.0126 per thousand.

The corresponding reports for June show only 2,000,000 lb. of steam to heating and corresponding unit costs of $0.0134 for current and $0.0241 for air.

It will be noted that unit costs are given in three ways: "Generated, without overhead," "Generated" and "Delivered."

The foregoing statements were read and approved by Mr. Vaksdal, but he asked that certain points be emphasized. "Particularly," he said, "analyze and record everything down to the 'nth' degree. Know just where labor goes. Know where all purchased and generated commodities go and in what quantities. Finally, know—and have the man know—the exact duties of each man." Mr. Vaksdal means business in this last statement. He is at present engaged in charting the exact duties and responsibilities of each member of the plant engineering department from himself to the individual floor sweeper.

Each man will have a chart covering his own job. The total number of these charts will be around 500. It is expected that from their use will come a great increase in individual initiative, fewer "alibis" and better work all along the line.

Fans Cool Totally Inclosed Synchronous Motors

Synchronous motors of 250-hp. rating have been built that are totally inclosed and cooled by external and internal fans, for use in severe atmospheric conditions and to operate at a 5,000-ft. altitude

By C. C. SHUTT
Power Engineering Department
Westinghouse Elec. & Mfg. Co.

IN THE application of alternating-current motors to industrial drives there are a number of types of service for which it is desirable to completely inclose the machines. This is done largely to protect the windings from conducting or abrasive dust, moisture, or insulation-destroying fumes. Motors of this type usually have fans, both inside and outside of the inclosure, to facilitate cooling. Such construction also materially reduces fire and explosion hazards where inflammable dust or gas is present. However, the ordinary inclosed motor cannot be considered explosion-proof in the literal sense of being able mechanically to withstand the force of an explosion within the inclosing parts.

Examples of the more severe applications of these types are found in steel mills and industries manufacturing or plants using pulverized coal. The air available for cooling motors in such places is often filled with abrasive and conducting dust which may appreciably shorten the life of insulation. The air in flour mills usually contains a dust which not only presents a fire hazard, but also rapidly fills the ventilating ducts of the ordinary motor, and can, in a short time, materially decrease its rating as a result of excessive temperature rise. Lampblack, often present in rubber-mill atmosphere, is a good conducting dust. Also certain processes in industries such as the nitrate, deposit a dust on the windings that in the presence of moisture forms an acid which causes rapid deterioration of the insulation on the windings.

Fan-Cooled Induction Motors

It has been standard practice to meet the demand for totally inclosed motors with fan-cooled induction motors. This is undoubtedly the best practice for sizes up to around 50 hp. In fact, most of the demand for motors of this type has been for the smaller sizes. This is largely because it has been found more economical to use standard motors and provide clean rooms for their location, or to supply them with clean air through a system of ducts. These systems are obviously inflexible and represent a considerable investment in themselves.

Fig. 3 shows a cross-section of a small totally inclosed induction motor of a type in common use. It is fan-cooled, having two internal and one external air-circulating paths.

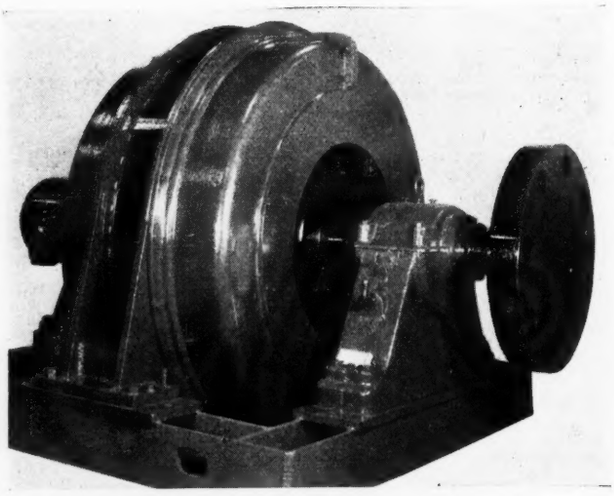


Fig. 1—A totally inclosed 250-hp., 450-r.p.m. synchronous motor

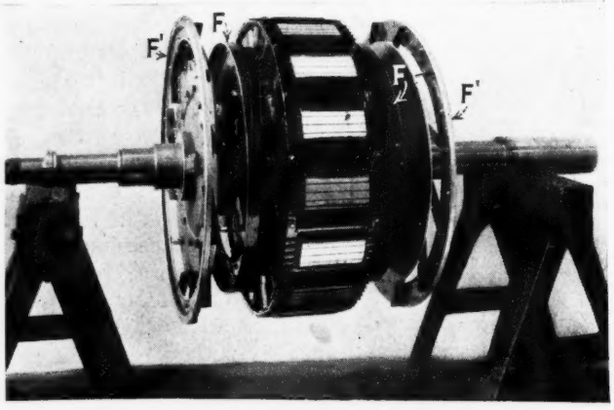


Fig. 2—Rotor of totally inclosed synchronous motor; the internal fans are at *F* and the external at *F'*

Because of the constant improvement of the starting performance of synchronous motors they are now being applied to industrial drives on which induction motors were formerly used exclusively. The demand for synchronous motors results largely from their higher efficiency and their ability to operate at unity or leading power factors. This has brought about a certain demand for synchronous motors of the totally inclosed, fan-cooled type. A cross-section of a bracket-type synchronous motor is inclosed and cooled with fans is shown in Fig. 4.

The motor is cooled by air circulating in each of four circuits. Two of these air paths are totally inclosed and two are open. Each is provided with its own circulating fan. It will be noted that the inner air path is sealed to the shaft by the inner end bell. The air in

the sealed paths picks up the heat from the field coils and from the end turns of the armature coils and transfers it to the inside surface of the inner end bell. This end bell has fins on the inside to provide a more effective absorbtion of heat. It also has fins on the outside to give better heat dissipation. The outer end bells serve to guide the air from the outer fans over the outside of the inner end bell. This air is discharged over the back of the stator punchings. The greater part of the heat generated in the stator punchings, as well as in the imbedded portion of the armature conductors, is dissipated through the back of the core. The slip rings are mounted in a separate inclosure, with the field-coil leads brought out through the shaft.

Eight 250-Hp. Synchronous Motors

Eight totally inclosed, fan-cooled synchronous motors have recently been completed for the Anglo Chilean Nitrate Company in South America. The motors, one of which is shown in Fig. 1, are rated at 250 hp., 450 r.p.m. at 90 per cent power factor. They are believed to be the largest synchronous motors of this type ever built. The operating temperature is 55 deg. C. at 5,000 ft. altitude.

These motors have fabricated construction throughout, except for the end bells and bearing pedestals, which are cast. The stator punchings are stacked on bolts. The scheme of ventilation is practically the same as that shown in Fig. 4.

Fig. 2 shows the rotor complete with its four sets of fans, *F* and *F'*. All fans are of the shrouded type, and, combined with effective guide vanes in the air path, give a relatively efficient ventilating system. Since these motors had rather high starting and pull-in torques, the frame is somewhat larger than for a normal machine, and little further increase in size was required to meet the temperature rating as an inclosed motor.

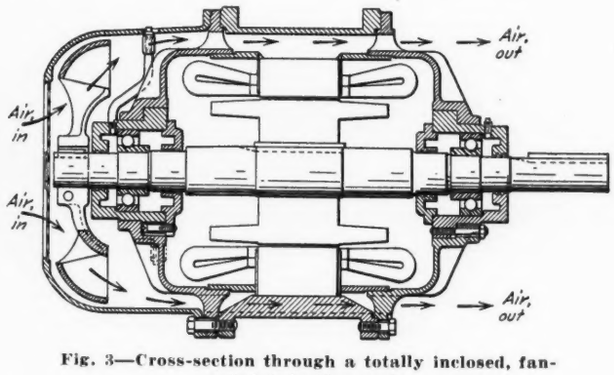


Fig. 3—Cross-section through a totally inclosed, fan-cooled induction motor

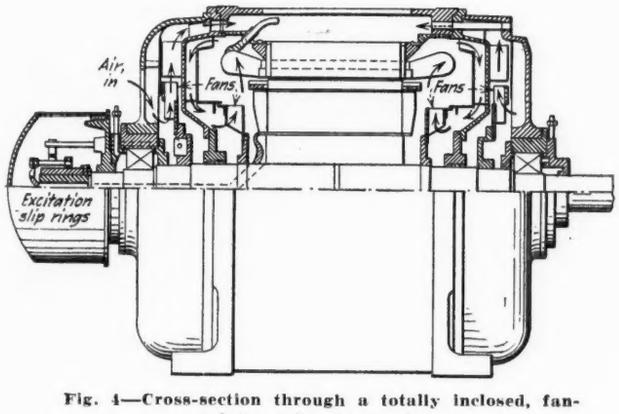


Fig. 4—Cross-section through a totally inclosed, fan-cooled synchronous motor

Delaying Needed Improvements Cuts Down Profits

By COLLINS WRIGHT

Changes are possible in many power plants which will return greater dividends than any other investment that might be made. The average coal consumption per kilowatt-hour for the United States has been cut in two in slightly over ten years. And this change has come without help from any of the smaller units, which still use as much or more coal than they did ten years ago.

A compound-condensing engine had been an important part of the machinery exhibit at the Chicago World's Fair Exposition in 1893. It had been purchased by a man of judgment, run on an average of over a hundred hours a week for 38 years, and was still in good condition. It had helped make its owner the wealthiest man in a community of ten thousand people. Though still far too good for the junk pile, it was being replaced by more modern equipment.

Some two years ago another mill in the neighborhood wrecked its engine. To avoid delay and to keep down the repair cost, motors were installed and power purchased, though steam was required for heating and cooking. Each power bill cut into an already small profit. When sales fell off the kilowatt rate advanced sharply to provide the demand charges. This mill had boilers good for but 100 lb. pressure. A study of conditions indicated that the 1893 compound engine could more than cut the power bill in half when operating at the 100 lb. pressure. The engine was offered to the mill on the basis of what it would save in 75 days' operation. The entire installation would have paid for itself in less than four months. Yet after considerable deliberation the management decided to repair their own engine some day and thus save handling and foundation charges. The saving which would have come from compound cylinders and condensing operation was apparently not understood, nor was the fact that the extra cost of purchased power since the accident would easily have paid for the entire new installation more than six times over. Here was management drifting along, blaming the times, and spending years and dollars while deliberating. If a saving is sound, it should be made; if repairs are preferable, they should not be delayed.

Several years ago another corliss had to be removed to make room for improvements. Here again the executives hesitated to spend any money. They already had a less desirable engine. However, they went ahead after the manager offered to finance the change personally in exchange for the saving. This installation paid for itself in less than 3,000 hours.

The World's Fair engine did not go into service. Neither did it go to the junk pile. It is to have a place of honor in a museum of equipment which shows the development of power machinery. It is a wonderful thing that some one is willing and able to provide such an exhibit. On the other hand, the fact that a unit entitled to a place in a museum was still able to save more than an industry was earning is a severe indictment of both management and engineering in some of our plants. It does not entitle them to sympathy when times are bad. Wealth has come from the aggressive development of ideas and from natural resources.

Progress on the Rock Island Development

By T. B. PARKER
Project Engineer
Stone & Webster Engineering Corp.
Boston, Mass.

THE Rock Island development on the Columbia River is the latest water power development of the Puget Sound Power & Light Company, which is the principal distributor of power in Western Washington. The site of this development is about twelve miles downstream from Wenatchee, Wash., and about one hundred miles east of Seattle and Everett.

The station has been planned on the basis of an ultimate capacity of ten 15,000-kw. generating units, with provision for the possible later addition of two more units of like capacity. The initial installation will be four units, or 60,000 kilowatts.

At the island, which gives the site its name, the river divides into two nearly equal branches and flows through a rocky gorge about half a mile long. The power house is in the left or east channel at an angle with the direction of flow. It is connected to the east bank by a gravity bulkhead section, and with the island by a section of spillway with large flood gates. A similar spillway is being constructed across the west channel.

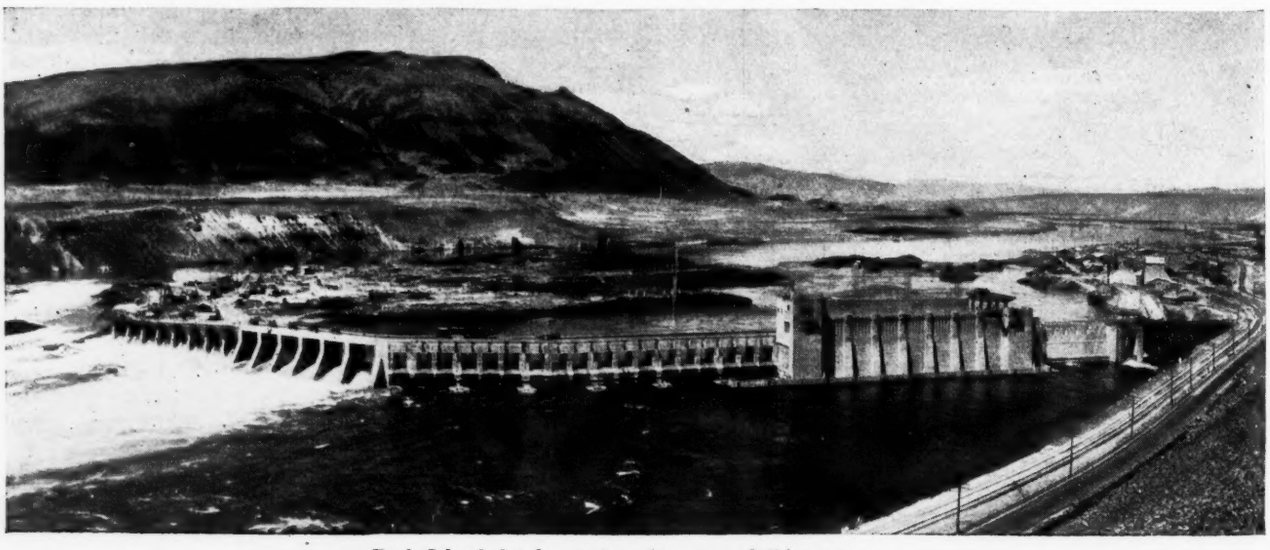
When the dam is completed a maximum head of nearly 51 ft. will be available at low water. For larger flows in the river the head is greatly diminished, and it is the production of the necessary power under a reduced head which is one of the most interesting features of this development. The waterwheels, especially designed to meet this condition, are of the propeller type, with adjustable vanes, the largest of this type so far installed in the United States. The pitch of the vanes can be varied to suit conditions, so that good efficiency can be maintained through a wide range of head. By this means the rated capacity of each unit, namely 15,000 kw., can be developed with the head reduced to 32 feet.

The most difficult construction problem has been the unwatering of the site. Each of the two channels has an average width at low water of 300 ft., with depths varying from 10 to 60 ft. The river flows with considerable turbulence through these channels, the bottoms of which are of hard basaltic rock, worn and eroded into rough and jagged outlines. The unusual roughness of these bottoms made it difficult to construct water-tight cofferdams. The method of unwatering adopted has been first to divert all flow west of the island and build the power house and dam in the east channel; then to divert water through openings in the east channel structures and construct the dam in the west channel.

The low water period, during which it is possible to divert the river, usually extends from September to April, inclusive, so that it has been necessary to do the bulk of the work during that part of the year. The winter of 1929-30 was a season of unusually low stream flow on the Columbia River. Taking advantage of this condition, cofferdams in the east channel were started in February, 1930, to get as much of the preliminary work as possible out of the way before the following construction season. With the help of favorable weather both upstream and downstream cofferdams were completed to within 10 ft. of their ultimate heights before the spring floods.

During the late spring and summer water continued to pass over the cofferdams, reaching a maximum depth of 11 ft. over the upper cribs, but causing little damage. During this period active work on the job was confined to the assembling of construction plant and equipment. Low water conditions returned in the late summer, and by the last of August the space between the cofferdams was completely pumped out. Work was immediately pushed on the excavation and concrete work, to avoid pouring concrete during the extreme cold weather, which usually visits this locality in mid-winter. As many as 2,765 men were employed at one time, and by the first of the year practically the whole east channel dam and abutment and the power house substructure were finished.

Cofferdams in the west channel were started in February, 1931. The downstream barrier was completed to its full height, and the upstream coffer to within 10 ft. of its ultimate height, before being topped by high water early in May. These cofferdams are larger structures than those previously constructed in the east channel, and will have the unusual maximum height of nearly 70 ft., with a corresponding base width of over 100 ft. The ordinary type of rock-filled cribwork was used, but with



Rock Island development as it appeared this summer

elaborate precautions to prevent underscour and to reduce the amount of flood damage.

Owing to the obstruction caused by the completed structures in the east channel, a larger proportion of the 1931 flood waters were diverted through the west channel than were passed down the east side of the island in 1930. This resulted in a maximum depth of about 20 ft. over the upper cofferdam in the west channel.

During the 1931 high-water season the station superstructure has been built and much of the equipment installed. As soon as the floods recede water will be diverted from the west channel through gate openings in the east channel structures, and the west channel spillway will be constructed.

The crest of the upstream cofferdam in the west channel, when completed, will be at nearly the elevation of the initial crest of the dam. As soon as this cofferdam is raised, sufficient head will be available for operating one or two units, should this prove desirable. Whether or not actual operation will be attempted under these conditions will depend upon river conditions and the need for power on the company's system. It is expected to have the plant completed and all units ready for operation by Aug. 1, 1932.

Stone & Webster Engineering Corporation have the contract for the design and construction of the entire development. All construction is under the general direction of W. D. Shannon, general superintendent, and H. F. Anthony, project manager. R. E. McGrew is superintendent at the Rock Island station, and T. H. Campbell superintendent on the transmission line construction.

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Emergency Full-Voltage Starting Of Synchronous Motors

By CARL C. NELSON
Control Engineer
Electric Machinery Manufacturing Company

AIR COMPRESSORS, ammonia compressors and similar drives are often difficult to start on cold mornings on account of the stiffening of the oil in the bearings. This is especially true where the motor is started on reduced voltage, part winding, or with a reactor, any of which methods may not provide sufficient torque to overcome the above condition.

The trouble is often overcome by barring over the compressor. On automatic starters an emergency full-voltage push button can be provided in addition to the normal reduced-voltage push button. The operator can thus start on reduced voltage or full voltage, as desired. Where the motor cannot be seen from the push buttons, the operator cannot easily determine if it starts on reduced voltage. Even when the motor is visible from the push buttons failure to start on reduced voltage a number of times soon causes the operator to get into the habit of starting on full voltage every time. With float switch, or pressure switch, that is, automatic start and stop operation, there is no operator at hand to put full voltage on in case the motor fails to start on reduced voltage.

With automatic emergency full-voltage starting the operator has no control over starting on reduced or full voltage. The control automatically decides whether full voltage is required to provide torque enough to start the motor turning over. Thus the motor starts on full voltage only when actually required, the high current inrush being limited to those times, and low inrush being retained at all other times when the torque obtained on reduced voltage is sufficient. Furthermore, the operator is assured of the motor's starting the load, and can leave the push button immediately after it is pressed, even though the motor is out of sight.

Automatic emergency full-voltage starting is accomplished by a balanced-frequency relay. The start button is pressed, which, in turn, causes reduced voltage to be applied to the motor's terminals. With the rotor at standstill there is induced in the field-discharge circuit a voltage the frequency of which is the same as that of the voltage applied to the terminals of the motor. As the rotor picks up speed the frequency in the field-discharge circuit decreases until at synchronous speed the frequency becomes zero.

In regular operation transfer to full voltage, or full winding if part winding starting system is used, may be made at 65 per cent speed, (say in six seconds) by means of a frequency-type transfer relay. With automatic emergency full-voltage starting a short-time relay is used in conjunction with the balanced-frequency relay. The short-time relay may be set for one second, which gives sufficient time for the control to determine whether the motor will start on reduced voltage.

In case the motor does not start on reduced voltage the balanced-frequency relay remains in balance and allows the short-time relay to cause transfer to full voltage immediately, thereby allowing the motor to exert enough torque to start and accelerate the load to synchronous speed. The balanced-frequency relay is set so that its armature unbalances at, say, 56 cycles on a 60-cycle motor. If the motor starts turning, the frequency in the rotor circuit decreases to 56 cycles, the relay unbalances and cuts out the short-time relay before it operates. The motor continues to pickup speed, making the regular transfer to full voltage at 65 per cent speed and then accelerating to 95 per cent speed, at which time it synchronizes.

When acceleration to 65 or 70 per cent speed on reduced voltage or part winding is necessary, such as with a line shaft with numerous belts, the control can be arranged to select automatically reduced or full voltage—whichever may be required to start it turning over Then as soon as this is accomplished it will return to reduced voltage and later transfer to full voltage or full winding in the regular manner.

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THE NEED for a safety shut-off valve on oil lines leading to oil burners was demonstrated by an accident some time ago. There were twin strainers at the front of a furnace connected to the burners. One strainer was cleaned every four hours. One day the fireman neglected to close the valves on the strainer to be cleaned, and loosened the bolts holding the bonnet in place. Immediately following the removal of the bolts the bonnet blew off. The hot oil created an inferno that defied approach until the emergency stop valve from the tank was closed. By that time considerable damage had been done. To prevent future accidents of this kind, the installation was fitted with a spring-loaded diaphragm valve, the valve being held open by the pressure on the line. When the pressure is suddenly released, the spring closes the valve and shuts off the oil.

READERS' COMMENTS

Hot Water and Cold Air From A Refrigerating System

IN THE July 14 number, in a contribution by A. F. Sheehan, certain calculations are given along the plan suggested by me in an article "Hot Water and Cold Air From a Refrigerating System," published in the May 19 number.

I agree with the figures and statements by Mr. Sheehan, and under the conditions as outlined by him my suggestion would hardly be practical. However, in writing the article I took local conditions into consideration, and being a resident of the Southwest, where the climate is entirely different from New England, I was naturally influenced by these conditions.

The rate 1.8c. per horsepower-hour, as stated, is rather high. In fact it is more than twice the rate in my community, where it is possible to get a rate of 0.8c. per horsepower-hour on 250 hp. and over. While the rate for this amount graduates from 2c. for the first 50 kw.-hr. in a building of the size requiring such a large refrigerating installation, the motor load for other purposes is large enough to allow the lower rate of 0.8 per horsepower-hour as an estimate on this installation.

Taking Mr. Sheehan's figures, the cost of producing hot water by my suggested method will just about equal the cost of heating water with $7-a-ton coal (which, by the way, cannot be had in my community). Besides, the air-cooling would be a byproduct.

However, the use of refrigeration for heating purposes would probably not be advisable in locations where fuel is low in cost and electric rates are high. There are localities where coal or other fuel is hard to obtain, but where electric heat is comparatively reasonable in cost. In such localities the advantages of heating by refrigeration will be increased efficiency. Mr. Sheehan's figures show that with an expenditure of 954,750 B.t.u. of electric energy 2,189,889 B.t.u. will be available for heat, and if refrigeration installation is in any case necessary for cooling purposes it would not add very much to make this cooling installation also suitable for heating purposes, eliminating direct fuel-burning appliances.

San Diego, Calif. B. F. RANDEL.

Operating a Centrifugal Boiler-Feed Pump With Throttled Discharge

I WAS much interested in the question in the June 23 number with regard to the operation of a centrifugal pump with throttled discharge and to the answers given to this question in the July 28 number.

Our night load gets very light and we have to change to a smaller boiler-feed pump; then we must throttle the pump down to keep 450 lb. pressure on the feed line at the boiler. We obtain this pressure by throttling the discharge valve, on some occasions it being closed off almost entirely. Not long ago the pump was taken down for inspection and it did not show any signs of wear from being operated with a throttled discharge.

The pump is a 600-g.p.m., double-suction, horizontal centrifugal unit embodying the Jeansville pattern. It is fitted with a bronze-covered steel shaft, bronze impellers and bronze diffusion vanes and is connected direct through a flexible coupling to a four-pole, 250-hp., 1,800-r.p.m. synchronous motor. It has been our experience that throttling the discharge does no harm to the pump so long as sufficient water is discharged to carry away any heat generated therein. ROBERT F. CLARK.

Beaumont, Texas.

APPARENTLY the 750 lb. pressure [in the question in the June 23 number] recorded is pump shut-off pressure. This value, in itself, should not be objectionable if the feed system is designed properly, and is a reasonable shut-off value for a pump that develops 500 lb. pressure at the normal operating point.

It appears that the fault of the system is one of boiler-feed control rather than of pump selection or design. The control system should be so damped that it will not close the feed valves tightly at any time when the boiler is supplying load. The operating curve of the feed valves should be flattened so that the boiler-feed flow will follow evaporation rates more closely, and not, as at present, introduce slugs of water intermittently.

Buffalo, N. Y. E. C. KEEFE.

Location of Pulverized-Coal Igniter

THE CORRECT LOCATION of an oil burner type of igniter for pulverized-fuel furnaces is not so readily determined as would appear from the answers given in the Aug. 11 number.

The proper location of one or more igniters is dependent upon several essential factors: type of igniter and its capacity; type, size, and other characteristics of the burner; location of the burner in the furnace; relative location of the burners (if in multiple) to each other; direction of the fuel streams; size and shape of the combustion chamber; and relative accessibility of igniter and fuel controls.

For two burners so close together that the igniter flame would contact both fuel streams one igniter located centrally between, and on the level of, the burners would be sufficient. If a separate igniter for each burner be desired the proper location would be central with, and just below, the burner; if placed above the burner the igniter would not be within easy reach. The igniter nozzle should be at such an angle as will insure the flame's striking the fuel stream about three to four feet from the mouth of the burner.

If more convenient to locate the igniters on the side walls, equally satisfactory results would be obtained by locating them four to five feet back from the inside face of the front of the boiler, and approximately on the level of the centerline of the fuel stream. In this location one igniter would be sufficient if strong enough to throw a flame to the far fuel stream.

Definite location can be decided only by detailed consideration, though with the burner type of igniter, capable of throwing a flame fifteen to twenty feet, and reaching any part of the furnace (by multiple installation when necessary), the location need not be so precisely determined.

An additional feature of the burner type of igniter, and one of considerable value and utility, is in its ability, by its own power alone, to keep up steam under light load when the pulverized-fuel fire refuses to function satis-

factorily; for maintaining line pressure during stand-by periods and to bring the boiler back to line pressure from cold or banked condition; or when with no other power available the pulverized fuel could not be operated.

Such a burner, operating on any kind of oil, with or without air or steam for atomization, ignited electrically, in a few seconds, makes an ideal igniter, and entirely eliminates the necessity for any other method of initially heating up, banking or relighting, as well as all risk of explosion. It reduces loss of time and power, labor and expense from these causes, to an almost negligible item.

New York, N. Y. P. RICHARDSON.

Filtering Diesel Lubricating Oil

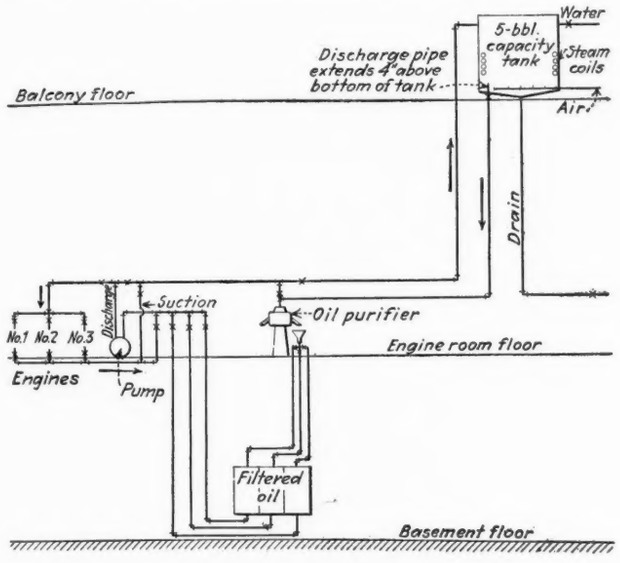
AT THE municipal electric light plant at Howarden, Iowa, we have experimented for several years with the reclamation of our diesel lubricating oil.

Our municipal plant was built in 1924 and included a 300-hp. and a 400-hp. diesel engine. In 1928 a 750-hp. diesel engine was installed and with it a centrifugal oil purifier.

Our practice at first consisted in pumping the oil from the crankcase directly through the centrifuge. We obtained a fair amount of carbon in the bowl, but the appearance of the cleaned oil indicated that a considerable amount of carbon remained in the oil, some of which a second run removed.

About this time we started, on a small scale, to wash the oil. We first tried water and soda, and water alone, which seemed to give satisfactory results; so a 5-bbl. steel tank was installed in connection with the purifier.

The accompanying sketch shows how the installation would be made if it were to be done over again. We have learned by experience that several mistakes were made in



Arrangement of tanks and piping for washing and purifying diesel engine lubricating oil

the original installation. One was placing the steam lines in the bottom of the tank, which made it difficult to clean the tank bottom. Also we arranged for the oil to settle in a tank in the basement and then pumped it up to the heating tank. This, of course, made the layout more complicated and added to the work of handling the oil.

The proposed procedure is first to pump the oil from an engine to the combination heating and washing tank which should contain several inches of water. The air and steam should then be turned on and continued until the temperature reaches approximately 180 deg., and then turned off and the water and sludge allowed to settle to the bottom of the tank. The oil, sludge and water should be allowed to remain for a week or more if possible. The drain valve should then be opened until the oil starts to come through. The oil is again heated to about 180 deg. and run through the purifier and into one of the reserve tanks in the basement. It can then be pumped back into an engine whenever desired.

Reference to the sketch will show that the oil in any engine can be pumped continuously through the centrifuge and back into the engine while it is in operation.

Some engineers might favor saving the oil that remains in the tank as a result of the discharge pipe extending about 4 in. above the bottom. In that case the remaining oil could be drained into a barrel and combined with the remaining oil from previous filterings. After standing for some time much of the oil in the barrel could be syphoned off and used again.

The present plant routine calls for a continuous treatment of the oil in the 750-hp. unit (run twelve hours daily) for six hours a day and a batch treatment once a month. The other two units are run less, so their oil is given only a batch treatment once a month. This practice seems to keep the crankcase oil in good condition and the crankcase clean. J. WILLARD PETERSON.

Sioux City, Iowa.

Pulverized Coal Under the Microscope

I HAVE READ with considerable interest the article of Douglas Henderson on pulverized-coal burning in the July 28th number of *Power*. Mr. Henderson has shown great ingenuity in combining the microscope with the seive and establishing some very interesting facts. There are several points, however, which may very likely be misleading and which I should like to call to your attention.

Sinnatt and Newall did a great deal of work several years ago in investigating coal particles after volatile matter had been driven out. They went so far as to study the interstices in cenosphere walls. Their work showed that the cenosphere form was found only with caking coals and that non-caking coals resulted in a solid coke particle. With the non-caking Western coals which we burn the cenosphere forms described by Mr. Henderson are not found.

Mr. Henderson also deduced from Figs. 5 and 6 that in this particular installation the material "that issued from the stack was *largely* carbon." It would be a most unusual pulverized-coal installation if this were true. It would appear that if the coarse material of Fig. 5 was largely carbon, and if the finer material of Fig. 6 was largely ash, then the still finer material that goes up the stack would contain still less carbon rather than more as Mr. Henderson assumes.

Also, I believe, it is misleading to state that the unaccounted-for losses in pulverized-coal boiler tests are exceptionally high. A complete test would not include the carbon and fly ash as an "unaccounted-for" loss, for this is one of the most important features of the test.

This type of research article expressed in simple terms appeals to me and I should like to see more.

St. Louis, Mo. E. H. TENNEY,
Chief Engineer,
Union Electric Light and Power Co.

FROM AMONG READERS' PROBLEMS

Conducted by
L. H. MORRISON

TEMPERATURE IN RADIATOR—*In a factory vacuum heating system where the steam supply is at 2 to 5 lb. pressure and there is 10 in. vacuum at the vacuum pump, what is the temperature of steam in the pipe coil and radiators?* C.L.

The pressure existing at the inlet of any radiator in the system depends upon the resistance to the flow of steam offered by the piping and fittings ahead of the radiator. In the same way the pressure in a return branch is greater than the pressure at the vacuum pump because of friction resistance in the return piping.

For practical purposes, the average pressure within a radiator or coil may be considered to be the mean of the pressures at the inlet and outlet connections. Satisfactory circulation usually can be maintained for 2 lb. per square inch of pressure between supply and return.

In a vacuum heating system where 10 lb. vacuum, or an absolute pressure of 9.8 lb. per square inch, is maintained at the vacuum pump the pressure in the return connections may be anything from 2 lb. below the pressure of the initial supply to about 10 lb. per square inch absolute, according to the size and nearness of the return connection to the vacuum pump. Hence, when the initial supply pressure of the system is 2 lb. gage, or 17 lb. abs., the average pressure within the coil will be something between $(17 + 10) \div 2 = 13\frac{1}{2}$ lb. abs., and $17 - 2 = 15$ lb. abs.; or the temperature corresponding with those pressures may be between 207 and 213 deg. F. With steam supplied to the system at 5 lb. gage, or 20 lb. abs., the average temperature within the coil will be something between $(20 + 10) \div 2 = 15$ lb. abs. and $20 - 2 = 18$ lb. abs., so that the steam within the coil will be at a temperature between 213 and $222\frac{1}{2}$ deg. F.

OPERATION OF AIR WASHER—*An air washer is being installed in our plant and arranged so that the water is continuously recirculated through the washer nozzles. They tell us that the washer will cool the air, but it seems to me that the water will very quickly be heated to the air temperature. Will you please explain how this works?* P.A.S.

The water in the air washer system when continuously recirculated approaches the wet-bulb temperature of the entering air. Under this condition water vaporizes into the air, and since the water is at the temperature of vaporization the latent heat comes from the sensible heat in the air, thus lowering its temperature.

The moisture content of the air is increased and its temperature lowered simultaneously, the process continuing until the air becomes saturated and its temperature reduced to the wet-bulb temperature, when no further exchange between sensible and latent heat is possible.

In an actual air washer the leaving air is generally a few degrees above the wet-bulb temperature. Thus if air of 40 per cent relative humidity and 80 deg. dry-bulb is drawn through the washer, the water in the washer will attain the wet-bulb temperature of 64 deg. The leaving air will have a temperature of say 68 deg. and a relative humidity of about 80 per cent.

GASES IN REFRIGERATING SYSTEM—*How can I determine if there are foreign gases in our refrigerating system?* G.R.P.

If the capacity of the plant has dropped and the head pressure persists in keeping above the pressure corresponding to the condenser temperature, foreign gases are usually the cause. To detect such gas, insert a hose connected to the condenser purge valve in a pail of water. The ammonia gas will be absorbed by the water, but the foreign gas will bubble up through the water.

PROTECTION OF FAN SHAFTS AGAINST CORROSION.—*We have two fans in our plants handling hot corrosive gases. These fans give trouble at the bearings from corrosion. How can it be eliminated?* A.S.R.

Probably the best way to stop this trouble is to chromium plate that part of the shaft in actual contact with the bearings. Experience has shown that chromium runs well on babbitt linings and also makes the shaft resistant to corrosion and pitting by acids.

PREVIOUS QUESTION DISCUSSED BY READERS

THE QUESTION

WE OPERATE a 1,000-kw. turbine with steam at 200 lb. and 100 deg. superheat and exhausting to a 2,750-sq.ft. two-pass condenser at 28 in. vacuum. It has been suggested that during the winter months we operate at 17 in. back pressure and use the hot circulating water in our hot-water heating system. Can the turbine and condenser be operated at these conditions, and what will be the approximate capacity of the unit? R. G.

WE HAVE TWO 6,000-kw. turbine units with 14,000-sq.ft. surface condensers that are used to furnish the heating system hot water during the winter months. Each condenser receives circulating water from two pumps of 5,000-gal. per minute capacity each. To control the temperature a cooling tower of about 10,000-gal. per minute capacity and a pump of 5,000-gal. to return the cooled water to the condenser inlet were installed. By regulating the amount of bleed-off water and the temperature of the returned water it is possible to maintain any heating system water temperature that is needed. The cooling towers have four motor-driven fans each.

These turbines will carry full load with no vacuum, but were built for this purpose. The supply head on the water system is 250 ft. and return head about 125 ft. when two circulating pumps are delivering to the heating system.

The water temperatures required for different outside temperatures with two pumps running are:

Outside Temperature, Deg.	Heating System Water Temperature, Deg.
54	100
32	140
10	181
−6	212

The United States Weather Bureau shows that the average temperature from Oct. 1 to May 1 for this city is 35.4 deg., so that the heating system water will average 140 deg. or less for the winter,

allowing a vacuum of around 22 or 23 inches.

There is no doubt whatever that a good saving can be made by a change to this method, and I should not expect to have any trouble with either the turbine or the condenser in so far as load capacity is concerned except when high-temperature water is required. For these conditions the turbine builder can give far more reliable data, and I recommend that it be obtained.

GEORGE DREYER.

Detroit, Mich.

WITH 200 lb. gage pressure and 100 deg. superheat, the total adiabatic heat drop to 28 in. vacuum is 362 B.t.u. The corresponding heat drop when operating at 17 in. vacuum is 247 B.t.u. The temperature at 17 in. abs. is 185 deg., and allowing 5 deg. terminal difference the condensate would be 180 deg. F. and the exit circulating water would probably be 10 deg. lower, or 170 deg.

Assuming a generator and turbine mechanical efficiency of 93 per cent, and a Rankine efficiency at 28 in. vacuum of about 72 per cent, the over-all efficiency will be 67 per cent. At 17 in. vacuum the Rankine efficiency would probably drop to 66 per cent, and the total efficiency would therefore be 61.5 per cent. Thus the heat drop utilized at 28 in. would be $0.67 \times 362 = 242$ B.t.u., resulting in a steam rate of 14.1 lb. per kw.-hr. At 17 in. vacuum the heat drop utilized would be $0.615 \times 247 = 152$ B.t.u. and show a water rate of 22.4 lb. per kilowatt-hour. However, I believe that the turbine would probably be able to carry about 700 kw. If the nozzles and wheels have an excess steam flow capacity of 15 per cent, or 16,200 lb. per hour, then the capacity would be 680 kilowatts.

Operation for water heating would consist in limiting the circulating water through the condenser so that the vacuum or the desired exit temperature circulating water is obtained.

The efficiency of this heating system can be calculated. At 700 kw. load the turbine would require, at 28 in. vacuum, 10,400 lb. of steam per hour. With 17 in. vacuum and 700 kw., 16,500 lb. of steam is required, a difference of 6,100 lb. more steam. The condenser will have to absorb $1259 - [152 + (180 - 32)] = 959$ B.t.u. per pound of steam, or $959 \times 16,500 = 15,800,000$ B.t.u. total. This will heat 122,000 lb. of water from 40 to 170 deg. To heat this same amount of water with high-pressure steam directly will require

$$\frac{15,900,000}{1,259 - (170 - 32)} = 14,200 \text{ lb. of}$$

high pressure steam, exclusive of heater radiation losses and assuming that the condensate is returned to the boilers and not used in process. Including radiation losses, this would probably be 15,000 lb. per hour, making a net saving of slightly less than 9,000 lb. of steam per hour, but involving a loss of about 30 per cent in the generating capacity of the turbine.

THEODORE MAYNZ.

Cleveland, Ohio.

A Question for Our Readers

Our boiler plant contains two stoker-fired 6,000-sq.ft. boilers which normally operate close to their capacity during an 8-hr. weekday. Shortly after the first of the year new equipment in the factory will demand about 7,000 lb. of steam per hour more than the boilers can produce at present for a period of about two hours each day. How can the capacity of our steam-generating plant be increased to meet this additional load without installing new boilers? L.G.M.

Suitable answers, if received promptly, will be paid for[1] when published

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THE 1,000-kw. turbine will probably have an efficiency ratio of about 60 per cent when operating with the steam conditions as given. The adiabatic heat drop available for work per pound of steam is 359 B.t.u. The actual heat converted to work will be 60 per cent of this, or 215.4 B.t.u. per pound. The amount of steam necessary to produce 1,000 kw. will be 15,800 pounds per hour.

$$\frac{1,000 \times 3,412}{215.4} = 15,820 \text{ B.t.u.}$$

It is assumed that 17 in. back pressure means 17 in. of mercury absolute exhaust pressure, as that will heat circulating water to about 180 deg., which is reasonable for a hot-water system. The capacity of the turbine being 1,000 kw., the governor valve will be wide open at this load, and the amount of steam passing through the nozzles of the first stage will be 15,820 lb. per hour. If the turbine is designed for the steam conditions given, raising the exhaust pressure will reduce the efficiency ratio to perhaps 55 per cent. The adiabatic heat drop for the proposed steam conditions is 241 B.t.u. per lb. and the heat utilized is 55 per cent of 241, or 132.5 B.t.u. The kilowatts that will be produced by the steam will be

$$\frac{15,820 \times 132.5}{3,412} = 614.$$

If additional nozzle area can be opened up into the first stage or if steam can be let into the second stage additional power can be developed, but if the normal nozzle area is all that is available the power which the turbine will develop is limited by the amount of steam that can get through the nozzles of the first stage when the governor valve is wide open. Since there is no appreciable difference in the amount of steam to be condensed the condenser will perform its work satisfactorily at the higher temperature level.

W. H. MARTIN.

Corvallis, Ore.

THE INFORMATION given in the question is sufficiently complete to warrant a very general solution. However, because of the highly variable characteristics of the different type and makes of turbines, it will be impossible to give an absolutely correct answer.

It will, of course, be possible to operate the turbine with 17 in. of back pressure, or about 12 in. of vacuum. But it is the 15 or 16 in. of vacuum lost that is most vital to the efficiency of the turbine. This arrangement at best would be only slightly more efficient than letting the turbine exhaust at atmospheric pressure.

It is the general assumption of most authorities that in reaction turbines such as the Parsons type the increase in steam consumption per each inch of loss in vacuum between 23 and 28 in. is approximately 5 per cent, and between 23 and 12 in. approximately 2.4 per cent. These, of course, are average values, for as the vacuum decreases the change in steam consumption per inch of loss in vacuum becomes gradually less pronounced.

From these values and assuming the steam flow necessary to generate 1,000 kw. at 28 in. of vacuum to be 100 per cent, it follows that the steam flow necessary to generate 1,000 kw. at 12 in. of vacuum is 151.4 per cent. If C is the capacity of the machine at the original 100 per cent steam flow, but with the vacuum reduced to 12 in., then $\frac{151.4}{1,000} = \frac{100}{C}$ or $C = \frac{100,000}{151.4} = 660$ kilowatts.

The machine would carry a load of 660 kw. using a 12-in. vacuum with the same steam flow and steam conditions at which it would carry a 1,000-kw. load using a 28-in. vacuum. The effect of reduced vacuum on an impulse turbine such as the Curtis is slightly more pronounced.

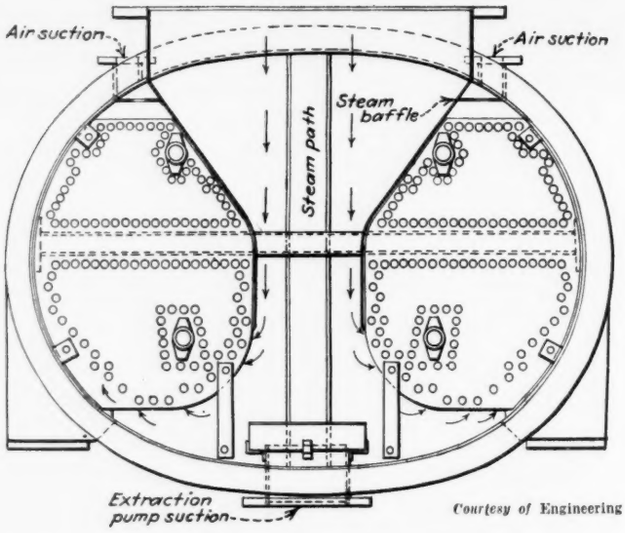
As can be seen, the cost of generation would be over 50 per cent more than the original total cost. At the same time the total investment in condensing equipment would be practically thrown away in so far as returns on it are concerned. This arrangement would seem to me highly impractical.

More definite information regarding this particular machine may be obtained from the manufacturer's vacuum correction curve for this turbine.

L. E. SHANK.

Michigan City, Ind.

[1] As an alternative to cash payment for answers published, readers may select any one of the following books. (Be sure to state the book desired.): Morrison's *American Diesel Engines*; Walker and Crocker's *Piping Handbook*; Norris and Therkeisen's *Heat Power*; Emswiler's *Thermodynamics*; Church's *Steam Turbines*; Uehling's *Heat Loss Analysis*; Croft's *Steam Power Plant Auxiliaries and Accessories*; Powell's *Boiler Feed Water Purification*; Osborne's *Power Plant Lubrication*; Moyer and Fritz' *Refrigeration*; Rietschel-Brabbee's *Heating and Ventilation*; Annett's *Electric Elevators*.



Arrangement of cooling surface in inverted condenser

Courtesy of Engineering

Inverted Condenser Prevents Subcooled Condensate*

A TWO-PASS 20,000-sq.ft. condenser of radically different design has recently been constructed by C. A. Parsons & Company, England. In this new type of condenser the usual arrangements are completely inverted, the steam flowing upward instead of downward through the tube banks, and the air being drawn off from the highest point in the shell. The inversion of the steam flow involves a corresponding inversion of the water flow, in order that the colder tubes may be at the top of the condenser instead of at the bottom. The new design, it is claimed, has a high coefficient of heat transfer, insures the condensate's being drawn off at the highest possible temperature consistent with the vacuum, and provides for cooling the air before removal by the dry vacuum pump.

As shown by the cross-section, steam enters through a central opening at the top, and is guided directly to the bottom of the condenser by baffles running the whole length of the condenser between the tube plates. At the bottom the steam flow divides and flows upward on each side until condensation is complete. The water of condensation formed on the tubes falls downward, since the coldest tubes are at the top, the water is never cooled by coming into contact with a tube colder than itself, as is almost inevitably the case with ordinary condenser, in which the coldest tubes are at the bottom.

The spacing of the tubes and the cross-sectional area of flow are diminished progressively from the bottom to the top of the condenser to maintain an approximately constant steam velocity. There are no baffles of any kind among the tubes, so that the flow of steam and air is unrestrained.

Inversion of the steam flow affords protection of the tubes from the impingement of water drops flung off at high velocity from the last row of the turbine blades. Thus the danger of tube leakage which may occur in an ordinary condenser as a result of the erosion of the upper tubes is largely eliminated.

*Abstract from *Engineering*, London, July 3, 1931.

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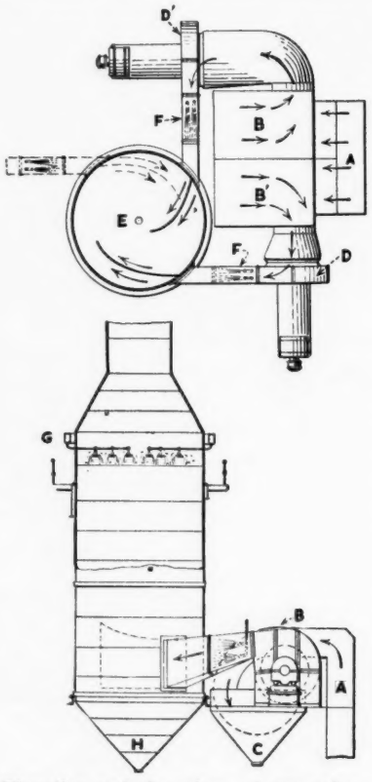
Removing Objectionable Products from Flue Gas

A RECENT ISSUE of *The Power Engineer*, London, carried the following description of the apparatus illustrated herewith for removing objectionable products from flue gas. *A* is the uptake from a boiler delivering laterally into two centrifugal separators *B* and *B'* which are regulated so as to leave a small proportion of finely divided solid matter in the gases, the separated solid matter being collected in hoppers *C*.



Elevation and plan views of apparatus for removing products from flue gas

Two fans *D* and *D'* draw the gases from the separators and deliver it in two streams to the purifying chamber *E*, each stream passing through a chamber or duct where it is sprayed with a fine water or steam spray from nozzles *F*. The fine spray is utilized to convert the sulphur dioxide in the flue gases into sulphur trioxide, which combines with water to form sulphuric acid distributed in a finely divided state in the bulk of the flue gases.

The stream of gas enters the main chamber tangentially, being also deflected by baffles and flow spirally upward. At the top a series of downwardly directed water nozzles are arranged to be fed from an annular tank *G*. Below each nozzle is suspended an adjustable splash plate, so that a uniform descending stream of comparatively large drops of water is produced in the chamber. The gas as it ascends is brought into intimate contact with the washing water, and the solid particles which were previously wetted, as well as the particles of sulphur acid solution, combine with the water and are carried down to the sump *H*, which is constructed of non-corrosive metal or is lead-lined.

▼

Brooklyn Poly Offers Many Graduate Courses

STARTING SEPT. 28, courses of interest to graduate engineers are being offered this fall in the day and evening curricula of the Polytechnic Institute of Brooklyn, N. Y. Included among those relating particularly to the field of power are evening courses in water-power engineering, power transmission and distribution theory, heat-power engineering, combustion engineering, and engineering economics. Full information may be obtained from Dean Erich Hausmann, Polytechnic Institute of Brooklyn, Court and Livington Sts., Brooklyn, N. Y.

▼

Dismissal Wage Surveyed By Conference Board

NO SERIOUS ATTEMPT has been made thus far in the United States to make the payment of a dismissal wage compulsory, but in some of the other countries such legislation has been enacted, states the National Industrial Conference Board. In Austria, after the World War, certain provisions were put into effect governing the discharge of workers. These provisions, however, were found to be so stringent as to render the discharge of an employee almost impossible, and they were later abandoned. In Mexico workers discharged through no fault of their own are allowed three months' pay; in Ecuador dismissed employees with more than one year's service are entitled to

two months' pay; in Bolivia the allowance is graduated from one month's pay for less than one year's service to twenty-five months' pay for 25 years' service or more. Voluntary dismissal wage plans are still few in number in the United States.

"It is recognized," states the report in conclusion, "that if industrial management refuses or fails to provide a constructive solution at least for the more pressing social problems that affect its employees it may expect the decision to be taken out of its hands on matters that it should determine. State Legislatures are showing each year a growing inclination to take an active part in dealing with these matters. The main drawback to adopting a dismissal wage policy is the uncertainty with regard to the expense it may involve at some time in the future. Against the cost may be set its salutary effect on employment and utilization of labor, its undoubted benefit to displaced workers, and its contribution toward social stability."

▼ ▼ ▼

Welded Diesel Engine Frames

From time to time attempts have been made to fabricate diesel engine frames by fusion welding, to save weight. It appears, however, that previous attempts along this line have been discarded, generally because the frame was unable to absorb shocks in a manner satisfactory to builders.

But the matter is not dead, and it is likely that efforts along this line will be continued until a completely satisfactory frame is obtained.

The latest design of welded diesel frame was illustrated and described in the July 17 *Engineering* (London) the accompanying illustrations and description being based on that source.

The system of construction has been patented by C. H. Stevens, of the Steel Barrel Company, Ltd., Uxbridge, and has been adopted by Messrs. Davey, Paxman, Ltd., Colchester, in their latest design of marine diesel engine.

It is clearly evident from Figs. 1 and 2 that the explosion stresses are taken up by a series of main frame plates, one of which is located between each pair of cylinders. No bolted horizontal joints are used.

Each of these frame plates is cut from a single rolled-steel plate. The method of assembly is shown in Fig. 1. In *A* are shown two plates *b* and *c* running the whole length of the engine. These are inserted as shown in *B*. The plan of the individual plate is shown at *C*.

A wrapper plate *k* (see *A*, Fig. 1) extends the whole length of the engine on both sides. Doors and handholes are provided as required.

The top and bottom ends of the plates act as girders, to take the reactions of the explosions and of the downthrust, respectively.

All joints are electrically welded, but none of the joints which join the longitudinal cylinder plates to the vertical frame plates is under stress in operation.

Fig. 2 shows the frame with one wrapper plate, and Fig. 3 the completed frame.

When the cylinders and water jackets are cast in one piece the frame is built up as shown in *D* of Fig. 1.

It is stated in *Engineering* that with this frame the total engine weight is 27 lb. per horsepower with present construction and that this weight can probably be reduced.

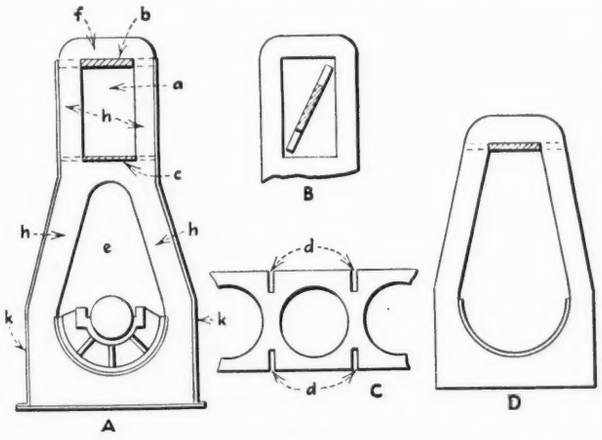


FIG. 1—WELDED DIESEL ENGINE FRAME

(*A*) End view of frame showing longitudinal plates *b* and *c*, and wrapper plate *k*. (*B*) Method of inserting longitudinal plate. (*C*) Plan view of longitudinal plates *b* and *c*. (*D*) Form of frame used where cylinder and water jackets are cast in one piece.

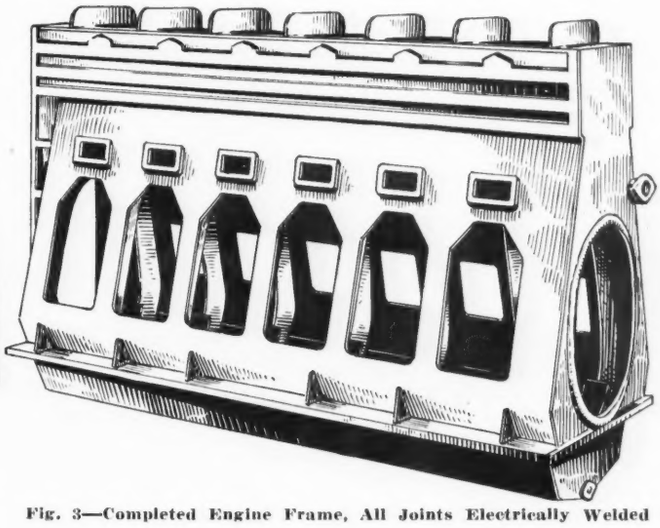


Fig. 3—Completed Engine Frame, All Joints Electrically Welded

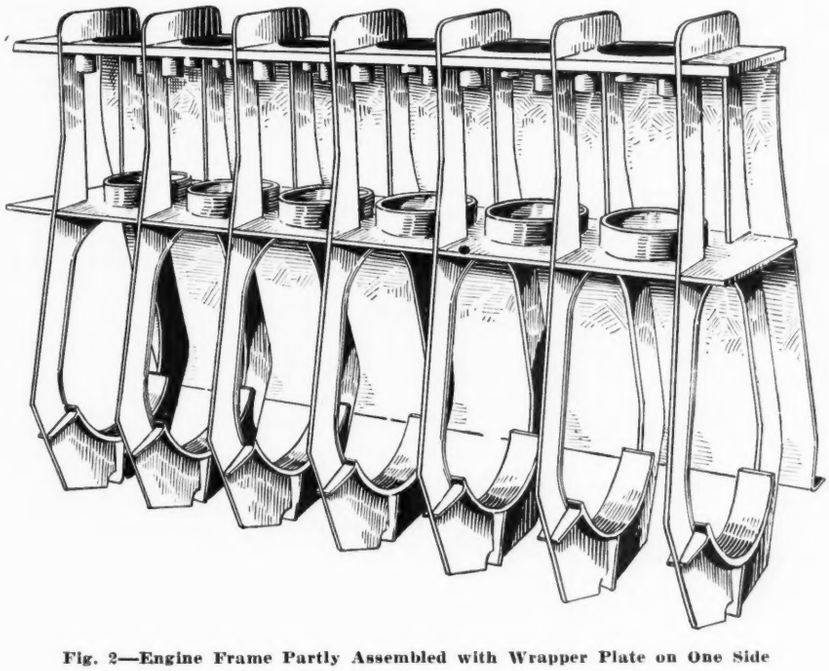
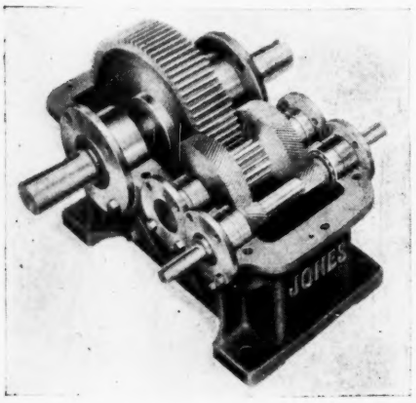


Fig. 2—Engine Frame Partly Assembled with Wrapper Plate on One Side

WHAT'S NEW IN PLANT EQUIPMENT

Small Speed Reducers

REDUCTION ratios of 12 to 1 up to 48 to 1 are afforded in a new series of small Herringbone-Maag speed reducers developed by the W. A. Jones Foundry & Machine Company, 4401 West Roosevelt Road, Chicago, Ill. Capacities range up to 18 hp. The smallest reducer in this series is 20 $\frac{5}{16}$ in. long and 14$\frac{1}{4}$ in. high. The base measures 10$\frac{1}{4}$ in. wide.



Jones Herringbone-Maag speed reducers

All the reducers in this series have high- and low-speed shaft extensions on both sides. This eliminates the need of a right- or left-hand assembly. Two shaft guards are provided. The high-speed pinion is forged integral with the shaft, of chrome-nickel steel. The low-speed pinion is also of chrome-nickel steel, with integral shafts projecting on each side for mounting the high-speed gears and bearings. Roller bearings are used throughout.

Manganese Electrode

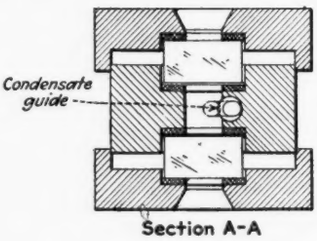
AN ELECTRODE which utilizes the "shielded-arc" process to build up worn manganese steel castings has been developed by the Lincoln Electric Company, Cleveland, Ohio. The new electrode, known as "Manganweld," is said to produce a weld with the structure and qualities of wear-resisting cast manganese steel.

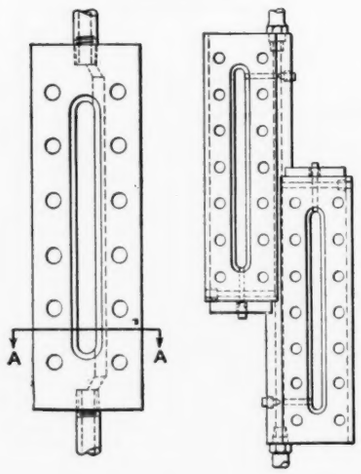
The electrodes are 11 to 15 per cent manganese steel and the weld is "air-toughening," which eliminates the necessity of quenching the bead. A heavy extruded coating provides a shielded arc, allowing the transfer of metal to take place under non-oxidizing conditions. This coating also insures a minimum of arc disturbance and boiling in the crater, and provides a layer of easily removable slag which further protects the weld from the harmful effects of the air. Manganese electrodes are available in $\frac{1}{8}$-, $\frac{5}{32}$-, $\frac{3}{16}$- and $\frac{1}{4}$-in. sizes of the standard 14-in. lengths.

Flat Glass Water Gage With Condensate Guide

IMPROVED VISIBILITY and increased life of the glass through the use of a condensate guide are features of the Yarway flat glass steel gage insert recently developed by the Yarnall-Waring Company, Chestnut Hill, Philadelphia, Pa.

As will be seen from the illustration, the condensate guide consists of a channel of circular cross-section, drilled through the insert body parallel to, and connected with, the glass chamber. The top and bottom gage connections discharge directly into the condensate guide, thus causing the condensate to run down the guide instead of down the glass. This feature permits of the use of thinner mica protection faces than would otherwise be possible.





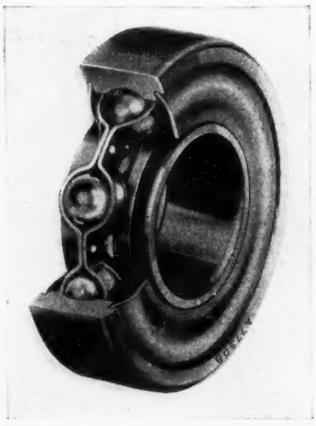
Cross-section through gage body and front views of two- and four-glass types

The gage inserts are machined from solid rolled steel bars, and the gage valves are of forged steel, monel-trimmed, with renewable seats. The gage is made in two- and four-glass types as illustrated.

Motor Double-Sealed Ball Bearing

A DOUBLED-SEALED ball bearing is now the standard anti-friction bearing on all "Red Band" motors manufactured by the Howell Electric Motors Company, Howell, Mich.

The balls and ball raceway of this bearing are packed in congealed oil and completely sealed in a dustproof room at the point of manufacture. The seal, which consists of two plates—one on each side—is designed to prevent dust, dirt, residue from grease or any injurious foreign material from entering the raceway in operation.

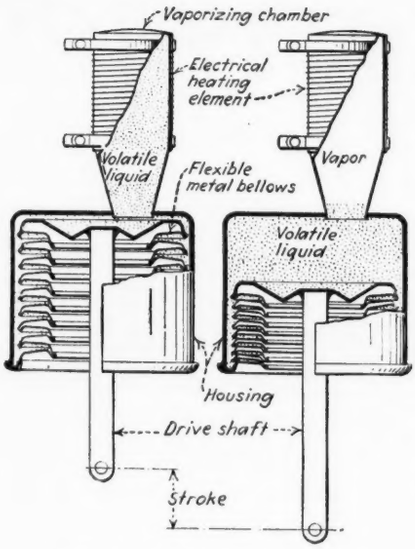


Double-sealed bearing is standard on "Red Band" motors

According to the manufacturer, as this bearing needs lubrication it automatically uses only the fine oily part of the grease in the outside bearing chamber, or the upper bearing chamber if it is a vertical motor. The inside bearing chambers on the horizontal motors or the lower bearing chambers on the vertical motors contain no grease which can be forced into the motor. When repairs require that the bearing be taken out of the housing, the fact that it is totally inclosed makes it easy to handle and prevents dirt from entering.

Electric Vapor Motor

IN THE OPERATION of the electric vapor motor put out by the Cook Electric Company, 2700 Southport Ave., Chicago, Ill., electric current is supplied to the heating element through a thermostat or other current-controlling device. The heat generated vaporizes a small quantity of liquid in the bulb. The



Detail of Cook electric vapor motor

vapor, in expanding, drives the remaining liquid out of the vaporizing bulb into the housing, forcing the flexible bellows to contract. This contraction moves the drive shaft through its stroke. The length of stroke and power developed are variable over a wide range by the use of bellows of the proper diameter and length and a vaporizing bulb of the right size. The timing can be varied by varying the heating element and the volatile liquid.

Manual Across-the-Line Starter for Small Motors

FEATURES of this new starter (known as Bulletin 9115) for all types of alternating-current squirrel-cage motors up to 2 hp. are: small size; thermal overload relays; a poles trip on overload; twin-break, silver to silver butt-type contacts; easy operation; and a cover interlock.

The starter is $4\frac{7}{16}$ in. wide x $8\frac{9}{16}$ in. high x $3\frac{7}{8}$ in. deep, over-all, small enough to be mounted directly on a machine. The thermal overload relays operate directly on the contact mechanism and open all three poles on an overload. These overload relays use the same heater coils as other C-H starters.

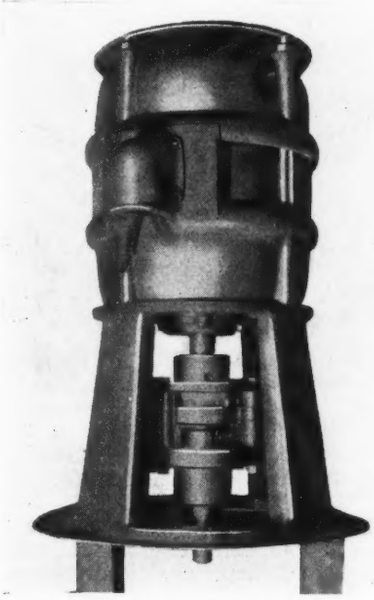
Starter for squirrel-cage motors

The twin-break contact mechanism gives a double break in each line, to reduce the voltage rise—and consequent arcing—when opening the circuit. The cover interlock prevents opening of the inclosing case if the motor is running—the operating lever must first be returned to the "off" position. The starter is manufactured by Cutler-Hammer, Inc., 294 North 12th St., Milwaukee, Wis.

Vertical Pump Coupling

THE PURPOSE of the Ideal vertical pump coupling for deepwell turbine pumps put out by the Ideal Electric & Manufacturing Company, Mansfield, Ohio, is to eliminate the necessity of using a special hollow-shaft motor.

With this coupling any standard solid-shaft vertical motor, including slip ring, direct-current and synchronous motors, can be used, as the coupling



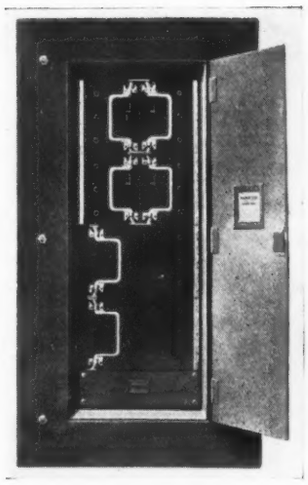
Coupling provides means of adjusting the position of the pump shaft

contains means of adjusting the position of the pump shaft as required.

The coupling is made in two types—one with backspin release, and one without this feature. The coupling without the backspin release provides for thrust in both up and down directions, as is required in some installations. The coupling with backspin release prevents backspin from unscrewing the shaft sections.

Shallow-Type Safety Panel

THIS new line of shallow safety panelboards put out by the Square D Company, Detroit, Mich. employs cabinets only 6 in. deep and 19 in. wide, which can be supplied for flush or surface mounting. The flush-mounted cabinets have trims equipped with self-adjusting trim clamps similar to those used on Square D lighting panels. Surface-



Flush-mounted shallow safety panelboard

mounted cabinets are supplied complete with hinged gutter covers and door.

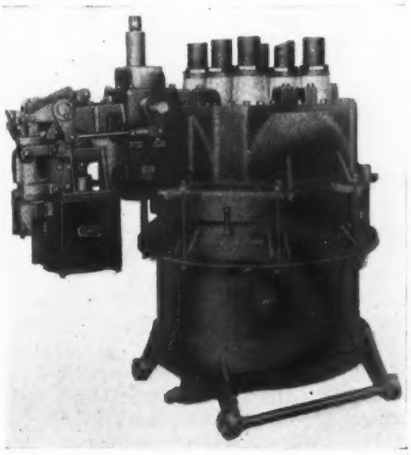
One of the main features of the new line is the fact that combination panels, including regular bakelite lighting panel sections, can be built up for such applications as service stations where a combination power and lighting panelboard conserves space.

Twin units are convertible between 30 and 60 amp., 125 or 250 volts, while the single units are convertible for 30-60-100 amp. fuse clips, 125 or 250 volts. All units are interchangeable.

Improved Oil Circuit Breaker

SUCH FEATURES as all poles in one tank, totally inclosed mechanism, oil and gas separator, and expulsion-type contacts, making possible small space requirements, quick-clearing operation, and freedom from oil throwing, are embodied in the new indoor oil circuit breaker known as Type DR140, put out by the Condit Electrical Manufacturing Corporation, Boston, Mass.

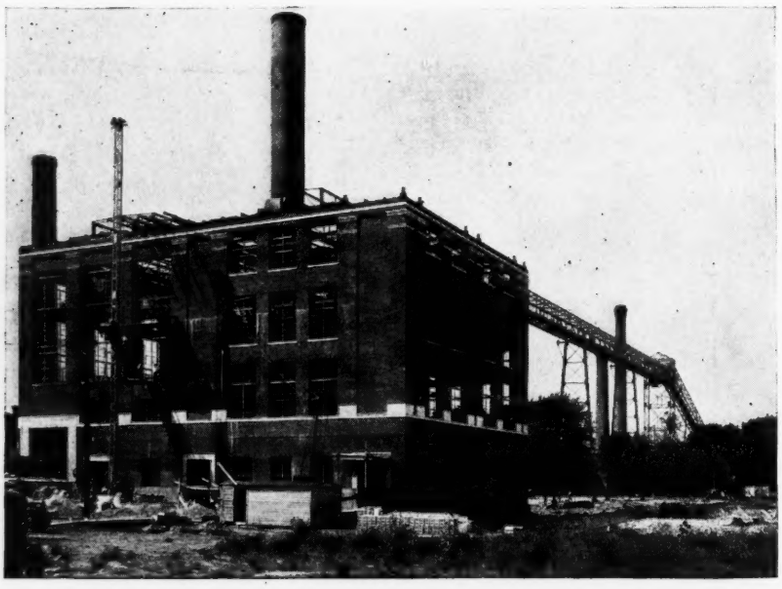
It is furnished three-pole, electrically operated, for 600, 1,200, 1,600 and 2,000 amp. at 15,000 volts; and 3,000 amp. at 7,500 volts. It is also furnished manually operated in the lower ampere capacities.



Type DR140 oil circuit breaker

NEWS of the FIELD

First Unit of 100,000-Kw. Municipal Steam Plant Nears Completion at Kansas City, Kan.



First section of the new 100,000-Kw. plant for Kansas City, Kan.

AS PART of its general plan for the development of a new 100,000-kw. steam station, the City of Kansas City, Kan., will complete and place in operation Oct. 1 the first 10,000-kw. unit of the new plant. With its present 30,000-kw. plant, which was started in 1912, the city serves some 33,000 customers with more than 600 power services, as well as operating a water plant that supplies the general water requirements of the community. Due to increasing demands, the Board of Public Utilities in 1929 approved a plan for the construction in three sections of a new 100,000-kw. station, which will gradually replace the present plant.

The first unit of the new station comprises an installation of one 10,000-kw., 13,200-volt, 3-phase, 60-cycle turbine-generator and one steam generating unit having a capacity of 150,000 lb. of steam per hour. Present steam demands run up to over 300,000 lb. per hour, so that this new boiler can supply a large portion of the steam needed and can carry one-half the load even during the peak demand. Steam pressure will be 400 lb. at the turbine throttle with 250 deg. of superheat. A steam line will connect the two power plants, using reducing valves and desuperheaters to reduce the 400-lb. steam to 175 lb. pressure and 100 deg. superheat for old plant use.

The boiler is provided with an economizer, air preheater and automatically controlled forced- and induced-draft fans. Coal will be delivered in hopper bottom cars to a track hopper, carried by a belt conveyor to a crusher house and thence by belt conveyor to the coal bunkers in front of the boilers. Spouts lead from these bunkers through weighing devices to feeders which automatically control the amount of coal to suit the load on the boiler. These feeders admit the coal to pulverizers, two of which are located in front of the boiler and each of a capacity to carry the boiler at ordinary load. The boiler is of the steam generator type with furnace water walls. The coal used has an ash with a low fusing point, so that the furnace is of the water-bottom slag-tap variety. All ash will be withdrawn as molten slag into disintegrating chambers and sluiced to a central point, then pumped to an outside overhead receiving hopper located over the railroad track.

All future turbine-generating units in this plant will be of not less than 30,000 kw. capacity each. The old power plant produces a kilowatt-hour on about 31,000 B.t.u., as compared to an expected 18,000 B.t.u. for the new plant. As installed the new units will be used as much as possible to carry the base load, leaving the old plant to absorb the peaks.

An unusual feature of the new plant is the circulation of the water supply through the surface condensers and thence to the settling basins. As the circulating water requirement at all times exceeds the needs of the water-works system, a remote controlled valve allows the excess to spill to a drainage ditch and thence back to the river.

The total installed cost is about $125 per kilowatt of generating capacity, but includes building space for an additional boiler to be installed shortly, coal and ash handling equipment large enough for the ultimate plant and circulating water lines of sufficient size for the future development. The total cost, approximating $1,300,000, is being paid for from earnings of the plant and without the issuance of any bonds.

The gross income for the year 1930 for the electric plant was $1,800,510.43 and the net income for this period was $458,792.81. This net income is after the payment of interest on outstanding bonds and providing for depreciation at the rate of 6 per cent on the invested value of the property, the total amount set aside for depreciation during the year 1930 being $266,494.92.

Both the water and light plants are under the control of a Board of Public Utilities consisting of five business men elected by the city at large for terms of four years. This Board employs two managers, one for production and distribution, who has charge of all operating and extension details; the other has charge of all collections and accounting. James D. Donovan is manager of production and distribution.

Third Coal Conference to Discuss Economic Problems

DUE TO THE world-wide depression in the coal industry, particular attention will be paid to economic problems at the Third International Conference on Bituminous Coal to be held Nov. 16 to 21 at Carnegie Institute of Technology, Pittsburgh, Pa., according to Dr. Thomas S. Baker, organizer of the meeting and president of the educational institution sponsoring it.

Several of the addresses will be concerned solely with the economics of coal. The leading address in this section will be delivered by Myron C.

Taylor, chairman of the finance committee of the U. S. Steel Corporation. One section of the conference will be devoted to the competition which exists between coal, petroleum, natural gas, and water power.

Twelve major topics of discussion have been tentatively announced by the program committee. Included in these are the status of low- and high-temperature distillation of coal, hydrogenation and gasification, cleaning and preparation of coal, by-products, railway and steamship fuels, smoke abatement, fertilizers, origin and classification of coal, and storage. Gas, pulverized coal, domestic heating and coal combustion generally will be discussed in a section devoted to combustion.

Scientists and business men from seventeen countries will take part in the sessions. Among the ninety papers to be read are: "Dust Removal From Flue Gases," A. W. Anthony; "Rationalizing Smoke Elimination Methods," V. J. Azbe; "Slag-Tap Furnace and Its Effect Upon the Selection of Coal for Pulverized-Coal Firing," E. G. Bailey; "Early History of Hydrogenation," F. Bergius; "Industrial Use of Off-Peak Power," F. G. Clark; "Relation of Chemical and Physical Tests of Coal to Coking Properties and By-Product Yields," A. C. Fieldner; "Study of the Mechanism of the Combustion of Pulverized Coal," A. Grebel.

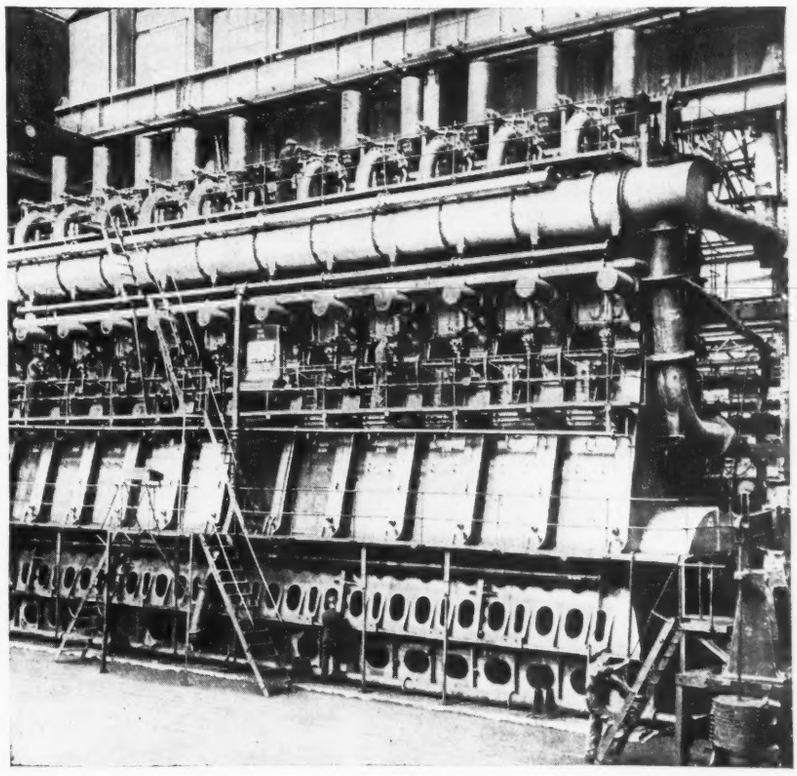
"Burning of Bituminous Coal on Large Underfeed Stokers," B. Houghton; "Use of Coal on Shipboard," C. J. Jefferson; "Elimination of Sulphur Compounds From Boiler Furnace Gases," H. F. Johnstone; "High Combustion Densities in Restricted Furnace Space," H. Nielsen; "Value of Clean Coal for Steam Production," E. B. Ricketts; "Physics of the Combustion of Coals—Heat Content-Temperature Diagram of Combustion," P. Rosin; "An Experimental Study of the Process of the Combustion of Pulverized Fuel," R. A. Sherman; "Theoretical and Practical Aspects of Pulverized-Coal Firing," E. H. Tenney; "Interrelationships of Coal, Petroleum and Natural Gas," W. T. Thom, Jr.

Engineer Advises Against Diesel Plant for San Diego

LESTER S. READY, San Francisco consulting engineer, employed by the Common Council of the City of San Diego, Calif., to determine the advisability of installing diesel equipment to serve a downtown lighting district, strongly advised against such a move in a report submitted to the council recently. Mr. Ready gave as his opinion that the installation of this equipment would increase the charge for street lighting service during the first five years' operation about $30,000 annually, and "that the average cost over a long period of time of street lighting service by a city-owned diesel-engine plant would not be less than that which the city should experience through the purchase of this same service from the San Diego Consolidated Gas & Electric Company." The engineer said that the power company "can and should reduce the charges for street lighting service in the city at this time by approximately $4,000 below the charges resulting from its proposed rate, provided the specifications for street lighting maintenance and operation are modified to comply generally with its proposal."

Mr. Ready also has been instructed by the council to prepare reports both on the feasibility of bringing natural gas to the San Diego territory and of the city's going into the manufacture and sale of gas and electricity in competition with the private company now in the field.

WORLD'S LARGEST MARINE DIESEL



One of the two Burmeister & Wayne 10,000-hp. 110-r.p.m. diesel engines, which will power the new White Star 27,000-ton passenger liner "Georgic," now being built in the Harland & Wolff yard at Belfast, Ireland. Said to be the largest of their kind in the world, these engines have ten cylinders each of 33-in. bore and 59-in. stroke, and will propel the ship at a speed of 17 knots an hour.

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A.W.S. to Hold Fall Meeting In Boston, Mass., Sept. 21-25

THE FALL MEETING of the American Welding Society will be held at the Copley-Plaza Hotel, Boston, Mass., on Sept. 21 to 25 inclusive. Technical papers on many phases of welding, committee reports and a special entertainment program comprise the features of the meeting. During the first four days a welding exposition will be held at Commonwealth Pier, where exhibits of the latest applications of welding, together with fabricating machinery and accessories of many manufacturers, will be on display.

Among the papers to be presented, the following are of particular interest to the power field: "Large Welded Everdur Pressure Vessels," Ira T. Hook and M. Powell; "Welding of Piping in New York Hospital—Cornell Medical Clinic," H. Samuelsen; "Welded Pipings and Fittings in Heating Installations," F. J. Maeurer; "Welding of Copper and Brass Piping," H. V. Inskeep; "The Relief of Welding Strains by Annealing," C. H. Jennings.

"Factors Affecting the Weldability of Steel," W. E. Stine; "Semi-Automatic Gas Welding," T. W. Greene; "Resistance Welding of Metal Fabric," W. T. Ober; "Four Problems Encountered in Flash-Welding Mild Steel," E. R. Torgler; "The Engineer, The Welder and The Foundryman," P. J. Horgan; "Maximum Stress—Its Influence on Cost and Service Life of a Structure," Everett Chapman; "Welding Galvanized Steel," H. F. Reinhard; "Fatigue Properties of Welds," R. A. Weinman.

Doherty Gives $500,000 For Unemployment Cure

HENRY L. DOHERTY, president of Henry L. Doherty & Company and affiliated public utilities, donated $500,000 on Sept. 9 to the American Society of Mechanical Engineers to study means of relieving the unemployment situation. Mr. Doherty made the donation after hearing Roy V. Wright, president of the A.S.M.E., urge those attending the Kansas City meeting "to bend their energies to obtain a $500,000 research fund to provide for a study of the present industrial situation and to work out ways of remedying it."

"Engineers and scientists," said Dr. Wright, "caused the industrial depression by invention of labor-saving devices. It is up to them to solve it."

South Carolina Power Tax Declared Constitutional

THE SOUTH CAROLINA TAX on electric power generated or sold in that state is constitutional, according to an opinon just handed down by a specially constituted three-judge federal court.

The proceeding was brought by the Broad River Power Company, the South Carolina Power Company and the Lexington Water Power Company, and was instituted soon after the passage by the 1931 South Carolina General Assembly of an act imposing a levy of one-half mill upon every kilowatt-hour of electric power generated or sold in the state.

Promise Adjustment of New Rates in New York

AS A RESULT of more than 450 complaints received by the New York Public Service Commission against the new electric rates charged by the New York Edison system in the metropolitan area, Chairman Milo R. Maltbie, announced on Sept. 8 that the commission would take all steps necessary to assure electric consumers the full benefit of the recent reductions, which the commission estimated would be at least $5,500,000 a year.

In a letter to Arthur J. W. Hilly, corporation counsel of New York City, who had complained on behalf of the city, Mr. Maltbie stated that certain modifications in the commercial rates had already been effected, particularly in relation to certain estimated demand charges. In many cases, he said, it had developed that owing to the depression consumers were using but a fraction of the installation capacity, while the demand charges were estimated on a 70 per cent basis. Mr. Maltbie said that the Edison company has recognized the injustice of these charges and has agreed to adjustments pending installation of demand meters.

COMING CONVENTIONS

American Society of Mechanical Engineers. Annual meeting in New York City, Nov. 30-Dec. 4. Secretary, Calvin W. Rice, 33 West 39th St., New York City.

American Association of Engineers. Seventeenth annual convention at Huntington, W. Va., Sept., 28-30. Secretary, M. E. McIver, Willoughby Tower, Chicago, Ill.

American Institute of Electrical Engineers. District meeting at Kansas City, Mo., Oct. 22-24. Annual winter convention in New York City, Jan. 25-29, 1932. Secretary, F. L. Hutchinson, 33 West 39th St., New York.

American Society of Refrigerating Engineers. Joint meeting with the A.S.H.V.E. and annual convention at the Hotel Cleveland, Cleveland, Ohio, Jan. 26-29, 1932. Secretary, David L. Fiske, 37 West 39th St., New York City.

American Welding Society. Fall meeting at the Copley-Plaza Hotel, Boston, Mass., Sept. 21-25. Secretary, M. M. Kelly, 33 West 39th St., New York City.

Association of Edison Illuminating Companies. Forty-seventh annual meeting at The Greenbrier, White Sulphur Springs, W. Va., Sept. 21-25. Secretary, Preston S. Millar, 80th St. and East End Ave., New York City.

National Association Practical Refrigerating Engineers. Annual convention and exhibition at the Municipal Auditorium, Houston, Tex., Nov. 10-13. Secretary, Edward H. Fox, 435 North Waller Ave., Chicago, Ill.

New England Water Works Association. Fiftieth annual convention at the Hotel Statler, Boston, Mass., Sept. 29-Oct. 2. Secretary, Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

Third International Conference on Bituminous Coal. At Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 16-21. Chairman, Thomas S. Baker, president of Carnegie Institute of Technology.

Dr. Harry P. Davis Dies

DR. HARRY PHILIPS DAVIS, vice-president and director of the Westinghouse Electric & Manufacturing Company and chairman of the National Broadcasting Company, died Sept. 10 at his home in Pittsburgh, Pa., following an illness of several months.

Born in Somersworth, N. H., in 1868, Dr. Davis was graduated from Worcester Polytechnic Institute. He joined the detail engineering department of the Westinghouse company in 1891. Five years later he was given charge of this department, and in 1904 he was made manager of the company's engineering department. He was elected vice-president in 1911.

Under Dr. Davis' leadership many of the most important advances of the electrical art were made. These related principally to meters, circuit breakers, railway control apparatus, transmission equipment and radio.

Personals

E. R. DAVIS, manager of construction of the Southern California Edison Company since 1921, has been appointed manager of construction and engineering for the company, with executive supervision of both these departments. In addition, the company announces the creation of an engineering executive committee consisting of FRED B. LEWIS, vice-president and assistant general manager; H. A. BARRE, chief engineer; and Mr. Davis. Mr. Davis, who has been with the company and its predecessors since 1896, played a prominent part in the construction of the Big Creek hydro-electric project.

OWEN D. YOUNG, chairman of the board of directors of the General Electric Company, has been appointed chairman of a committee to mobilize relief resources by WALTER S. GIFFORD, director of President Hoover's unemployment relief organization and chairman of the American Telephone & Telegraph Company. Mr. Gifford also appointed MATTHEW S. SLOAN, president of the New York Edison Company, a member of the committee of seventeen, which is responsible for the extension of emergency industrial policies of employment.

E. A. ROEHRY, formerly general manager of the St. Louis Electric Railway Terminal Company, has been made chief engineer of the central Illinois group of the Illinois Power & Light Corporation. This position is a new one recently created by the company. Mr. Roehry will have general engineering supervision of the six divisions of the central Illinois group.

C. A. ELLIOTT, for the past eleven years manager of the municipally owned light and water systems of San Augustine, Tex., tendered his resignation to the City Council on Sept. 5, to take effect immediately. Ill health was the reason for Mr. Elliott's resignation. G. C. MITCHELL, a member of the council, will be in charge of the systems until a successor to Mr. Elliott is named.

A. J. TROLLMAN, formerly connected with the Flint office of the Consumers Power Company, has been transferred to the engineering department at the company's Grand Rapids office. W. C. JOHNSON, formerly of the Jackson office, and W. C. COLEGROVE have also been added to the engineering department.

C. W. TRAUGHBER has been appointed technical and metallurgical advisor of the Northern Blower Company. Mr. Traughber, who was formerly associated with the Anaconda Copper Company, American Smelting & Refining Company and other large smelting plants, has had a wide experience in fumes, fly-ash and general dust problems.

Business Notes

JOHNS-MANVILLE SALES CORPORATION, New York City, announces that at the last meeting of its board of directors, the following vice-presidents were elected to have executive supervision of various territorial districts as indicated: T. K. Mial—Metropolitan, Boston, Philadelphia and New York State; R. C. Harden—Chicago, St. Louis, Denver and northwestern district; G. R. Lewis—Cleveland, Detroit, Pittsburgh and Cincinnati; J. M. Taylor—New Orleans, Atlanta and Houston; Franklin Shuey—San Francisco, Los Angeles and Seattle.

LUDLOW VALVE MANUFACTURING COMPANY, Troy, N. Y., announces that it will start manufacturing in Canada as the Canadian Ludlow Valve Manufacturing Company, Limited, with offices at 930 Wellington St., Montreal, Que., and factories at Three Rivers, Que., St. Thomas and Fort William, Ont. The company states that it will make the same line and quality of products in Canada as it has for many years in the United States.

PAGE STEEL & WIRE COMPANY (associate of the American Chain Company), Bridgeport, Conn., is opening a southeastern district sales office with headquarters at 1520 Healey Building, Atlanta, Ga. This new office, it is stated, will be in charge of R. J. Teeple, who will supervise the distribution of all Page products in the southeastern district.

GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has just leased the largest exhibit space yet contracted for in any of the buildings at the Chicago World's Fair of 1933. An area of 9,000 sq.ft. in the electrical building on Northerly Island at the exposition will be devoted to a comprehensive display of General Electric products.

INTERNATIONAL-STACEY CORPORATION, Columbus, Ohio, announces that B. T. Ehrnman, who was formerly located at the Chicago office, has been transferred to St. Louis as division manager, with offices at 2192 Railway Exchange Building.

AMERICAN MANGANESE STEEL COMPANY, Chicago Heights, Ill., announces that W. C. Bruton, for many years sales engineer attached to the Oakland (Calif.) office, has been appointed district sales manager of the Pacific northwest territory, comprising Oregon, Washington, British Columbia and the Coeur d'Alene district in Idaho. Mr. Bruton's headquarters will be located at 411 Colman Building, Seattle, Wash. Working with him will be the company's representatives in that territory, namely, P. R. Hines, Lewis Building, Portland, Ore., and Paragon Supplies, Ltd., 845 Hastings St., East Vancouver, British Columbia.

How's Business?

SLIGHT but belated signs of the autumn acceleration of activity appeared in the pre-Labor Day week, according to *The Business Week*, Sept. 16. Railroad movement of merchandise freight at last turned upward after a depressing period of persistent decline. Check payments gave some promise of responding to seasonal influences. Building contracts also improved from the disappointing early August level. Our index, after touching new lows in the middle of the month, rallied a little. Steel activity and power production alone reflect uncertainty about the extent of the usual Fall flurry. Though the seasonal turning point has passed, business is still not sure where the street leads.

Production of electricity by public utilities for the week ended Sept. 5 was 1,627,380,000 kw.-hr., according to N.E.L.A. figures. No comparisons can be made with the corresponding period of last year because in 1930 the week included Labor Day, while this year the holiday came a week later.

Trade Catalogs

SWITCHGEAR—Three new publications on switchgear and circuit breakers have just been issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Circulars 1899 and 1915 describe and illustrate the construction and installations of metal enclosed switchgear, while Circular 1921 covers outdoor low-capacity oil circuit breakers.

CHAIN DRIVES—Bulletin 44, recently issued by the Morse Chain Company, Ithaca, N. Y., contains specifications and prices of the full line of Morse stock chain drives.

PACKING—Engineering data on gaskets, gasket materials and many kinds of packing for industrial and commercial use is contained in Catalog H just issued by the Victor Manufacturing & Gasket Company, 5750 Roosevelt Road, Chicago, Ill. Many interesting illustrations are included in its 94 pages.

CLUTCHES—The Carlyle Johnson Machine Company, Manchester, Conn., has just issued a new catalog describing and illustrating the new "Super-Johnson" clutch, in which the expanding friction ring is faced on its outside diameter with a special heat-resisting material.

WIRE ROPE—A new 279-page general catalog of convenient pocket size has just been issued by the John A Roebling's Sons Company, Trenton, N. J. Bound in flexible cloth covers and fully illustrated, it contains descriptions, specifications and engineering data concerning the full line of wire rope, wire and wire products manufactured by the company.

BLOW DOWN—A complete description of the Elgin continuous blow-down system with the Eckel precision control is contained in a new illustrated bulletin recently issued by the Elgin Softener Corporation, Elgin, Ill.

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Fuel Prices

FUEL OIL

Boston—Sept. 1, tank-car lots, f.o.b. 12@14 deg. Baumé, 2.9c. per gal.; 28@32 deg., 4.85c. per gal.

New York—Sept. 10, f.o.b. Bayonne, N. J., 28@34 deg. Baumé, industrial use, tank-car lots, 3.75c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 4.75c. per gal.

Philadelphia—Sept. 2, No. 3 industrial gas oil, $1.83 per bbl.; No. 4, light industrial fuel oil, $1.31 per bbl.; No. 5, medium industrial fuel oil, $1.20 per bbl.; No. 6, heavy (Bunker C), $1.05 per bbl.

Pittsburgh—Sept. 2, f.o.b. local refinery, fuel oil, 36@40 deg., 2.875c. per gal.

Cincinnati — Sept. 8, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 4.5c. per gal.; 26@30 deg., 4.75c. per gal.; 30@32 deg., 5c. per gal.

Chicago—Sept. 1, tank-car lots, f.o.b. Oklahoma; freight to Chicago, 90c. per bbl. or 42 gal.; 18@22 deg., 22.5c. per bbl.; 22@24 deg., 25c. per bbl.; 24@26 deg., 27.5c. per bbl.; 26@28 deg., 32.5c. per bbl.; 28@30 deg., 37.5c. per bbl.

St. Louis — Sept. 2, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.02 per bbl., or 42 gal.; 26@28 deg., $1.095 per bbl.; 28@30 deg., $1.17 per bbl.; 30@32 deg., $1.22 per bbl.; 32@36 deg., gas oil, 2.901c. per gal.; 38@40 deg., distillate, 3.151c. per gal.

Dallas—Sept. 5, f.o.b. local refinery, 24@26 deg., 70c. per bbl. or 42 gallons.

COAL

Bituminous (Net Tons)	At Mine, for Shipments to	Price per Ton
Pool 9, super low-vol..	New York.	$1.60@$1.80
Pool 10, h. gr. low-vol..	New York	1.50@ 1.60
Pool 11, low-vol.....	New York.	1.35@ 1.45
Smokeless, mine-run...	Chicago...	1.50@ 1.75
Smokeless, slack.....	Chicago...	.50@ 1.10
Harlan, Ky., slack.....	Chicago...	.75@ 1.00
Franklin, Ill., mine-run	Chicago...	2.15
Franklin, Ill., screen....	Chicago...	1.20@ 1.60
Ind. 5th Vein, m.-r.....	Chicago...	1.20@ 1.75
Standard Ill., mine-run.	St. Louis...	1.25@ 1.40
W. Ky., mine-run.....	Louisville..	.85@ 1.25
W. Ky., slack.....	Louisville..	.35@ .60
Pittsburgh, mine-run...	Pittsburgh.	1.20@ 1.50
Smokeless, mine-run...	Cincinnati.	1.60@ 2.00
Smokeless, slack.....	Cincinnati.	.50@ .85
Kanawha, mine-run....	Cincinnati.	1.00@ 1.25
Kanawha, nut-slack....	Cincinnati.	.60@ .90
Anthracite (Net Tons)	At Mine, for Shipment to	Price per Ton
Buckwheat.....	New York.	$3.25
Barley.....	New York.	.90@ 1.40

NEW PLANT CONSTRUCTION

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Mare Island — Bureau of Yards & Docks, Navy Dept., Washington, D. C., had plans prepared for the construction of a 1 story battery storage plant here. Estimated cost $240,000.

Conn., Hamden (br. New Haven)—City is receiving bids for the construction of a sewage pumping station and overflow basin for completion of Spring Glen project. Estimated cost $25,000. F. Walden Wright, Town Hall, is engineer.

Ind., Huntingburg—City awarded contract for additions and alterations to municipal light plant to W. A. Armstrong, Somerville. Estimated cost $40,000.

Ind., South Bend — Notre Dame University, awarded contract for a 52 x 100 ft. addition to power plant to T. L. Hickey, 121 North Hill St. Estimated cost $65,000. Boilers, coal handling equipment, coal bunkers, etc. will be installed.

Ia., Lake Mills — City, J. D. Kent, Clk., awarded contract for the construction of a 38 x 52 ft. power and light plant including two Diesel engine generating units and complete distribution system to Fairbanks-Morse Co., 9th and Harney Sts., Omaha. $83,135.

Ia., Lenox—City, L. B. Carruthers, Clk., will receive bids until Sept. 22, for the construction of a municipal light and power plant. Estimated cost $22,000.

Mass., Boston — City Ice & Fuel Co., 6611 Euclid Ave., Cleveland, O., plans addition to ice manufacturing and storage plant here. Estimated cost $70,000.

Minn., Cambridge—State Board of Administration & Finance, Capitol, St. Paul, awarded contract for the construction of two cottages, and power plant at State Colony for Epileptics here to W. W. Magee, Commercial Bank Bldg., St. Paul. $363,000.

Mo., St. Louis—Board of Public Service, 208 City Hall, will soon receive bids for a 5 and 6 story hospital for negroes to include central building, service building, kitchen, laundry and shops on Kennerly Ave., Whittier St. and St. Ferdinand and Goode Aves. Estimated cost $900,000. A. Osburg, 301 City Hall, is architect. L. R. Bowen, 301 City Hall, is engineer.

Mo., Springfield—Bureau of Federal Prisons, c/o S. Bates, Supervisor, will receive bids about Oct. 1, for the construction of a group of hospital buildings for mental delinquents to include main building, continued treatment building, general infirmary, store house, laundry, etc. Estimated cost $2,500,000. J. A. Wetmore, U. S. Treasury Dept., Washington, D. C. Acting Supervising Architect, Joannes & Marlow, 420 Lexington Ave., New York, N. Y., are architects.

Mo., Sullivan—City voted $80,000 bonds for the construction of a light and power plant and distribution system. W. A. Fuller Co., 2916 Shenandoah Ave., St. Louis, is engineer.

Nev., Reno — Reno Sports Palace, P. E. Grosbeck, V. Pres., 420 Roberts St., awarded contract for a 175 x 228 ft. ice skating rink, including bowling alley, concession quarters and stores on East 4th St. to Ellis & Matteson, 228 North Virginia St.

N. H., Dover—City Water Dept., W. C. Campbell, Supt., is having plans prepared for the construction of a waterworks pumping station. Estimated cost $15,000. Weston & Sampson, 14 Beacon St., Boston, Mass., are engineers.

N. J., Jersey City—Owner, c/o C. Ziegler, 26 Journal Sq., Archt., is having plans prepared for a 1 story ice plant. Estimated cost $40,000.

N. Y., Brooklyn—Kings County Lighting Co., 6740 4th Ave., plans a 2 story addition to exhauster room at First Ave. and 54th St. Estimated cost $45,000. M. T. Ketz, 50 Church St., New York, is engineer.

N. Y., Coxsackie — Central Hudson Gas & Electric Co., 50 Market St., Poughkeepsie, has been granted permit by Public Service Commission, to construct a gas electric plant here 156,000 cu.ft. daily capacity, also distribution system. $43,121.

N. Y., Flushing—New York & Queens Electric Light & Power Co., 28-19 Bridge Plaza, Long Island City, plans the construction of a storage building at Roosevelt Ave. and Lawrence St. here. Estimated cost $40,000 including equipment.

N. Y., Lake Placid—City awarded contract for the construction of an indoor ice rink and arena to Arch Roof Construction Co., 104 West 42nd St., New York.

Tex., Crystal City — City plans an election Sept. 26 to vote $128,000 bonds for the construction of a light and power plant including distribution system. Fairbanks Morse Co., 900 South Wabash Ave., Chicago, Ill., are engineers.

Tex., Edcouch—R. E. Ewing, Santa Rosa, will build a 60 ton ice plant here. Estimated cost $80,000. Work will be done by owners forces.

Wis., Gresham — City, C. J. Ebert, Clk., awarded contract for the construction of a 1 story, 60 x 90 ft. hydro-electric plant to Ford Construction Co., 911 A. Jackson St., Janesville.

Tex., Mineola—City, c/o J. Russell, Mayor, will receive bids until Sept. 17, for improvements to sewage system including disposal plant, pumping station, etc. Montgomery & Ward, 544 Harvey-Snider Bldg., Wichita Falls, are engineers.

Wis., Oshkosh—M. C. Cohadas, 812 A Bound St., Appleton, Wis., is having plans prepared for a 2 story, 46 x 100 ft. cold storage plant and warehouse here. Estimated cost $40,000. D. E. Anderson, Marquette, Mich., is architect.

Wis., Waupaca—Wisconsin Veterans Home, c/o W. A. Holden, will receive bids until Sept. 17, for waterworks and sewage systems, including water purification plant and sewage disposal plant, paddle mixer and motor, 75 g.p.m. sludge pump, 15 cu.ft. blower and motor, etc. W. G. Kerchaffer, Madison, is engineer.

Ont., Toronto — Hydro-Electric Power Commission of Ontario, 190 University Ave., is having plans prepared for a 14 to 17 story addition to office building including steam heating system, elevators, etc. Estimated cost $2,000,000. Sproatt & Rolph, 1162 Bay St., are architects.

Que., St. Michel des Saints — Shawinigan Water & Power Co., Shawinigan Falls and 107 Craig St. W., Montreal, will build a hydro-electric power dam here. Estimated cost $25,000. Work will be done by owners forces.

Ontario — Abitibi Power & Paper Co., 88 University Ave., Toronto, awarded contract for 100 ton electric crane to Dominion Bridge Co., 1139 Shaw St., Toronto and steel transmission line towers for 114 miles of transmission line to Canadian Bridge Co. Ltd., Walker Road, Walkerville, in connection hydro-electric development on the Abitibi River at Abitibi Canyon. Other contracts awarded early in August include five 65,000 hp. turbines to Canadian Allis-Chalmers, 212 King St. W., Toronto; five 55,000 kva. transformers to Canadian General Electric Co., 212 King St. W., Toronto; sluice gates to Dominion Bridge Co. Ltd., 1139 Shaw St., Toronto; cable for 114 mi. of 132,000 v. double circuit transmission line to Aluminum Co. of Canada, 158 Sterling Rd., Toronto, insulators to Canadian Porcelain Co., Aberdeen Ave., Hamilton and Canadian Ohio Brass Co., Niagara Falls, and ground wire to Canada Wire & Cable Co., Leaside. Estimated total cost approximately $20,000,000.

Egypt, Cairo—Ministry of Interior, will receive bids until Dec. 22, for supply and erection of a complete electrical power station for town of Tantah.

T. H., Fort Shafter—U. S. Government, Constructing Quartermaster, postponed indefinitely additions and extensions to sewage system to include pumping plant, etc.

Equipment Wanted

Air Compressor—Altamont, Ill.—G. Winter, plans to purchase an air compressor, 2 cylinder, about 80 cu.ft., 80 lb. pressure.

Boilers, Blowers, Etc.—Omaha, Neb.—State Board of Control, State Capitol, Lincoln, will receive bids until Sept. 18 for furnishing and installing two water tube boilers, including breeching, soot blowers, feed water regulators, oil burning equipment, etc., for School for Deaf here.

Engines and Equipment—Kenyon, Minn. — City, A. S. Kindseth, Clk., will receive bids until Sept. 21, for furnishing and installing Diesel engines and equipment in connection with proposed power house and electrical distribution system.

Generator, Switching Equipment, Etc.—Ford City, Pa.—City, A. B. Mahoney, Clk., City Hall, will receive bids until Sept. 22, for Cont. 1 furnishing and installing two 250 or one 500 kw. Diesel oil engine generator, exciter and auxiliaries; Cont. 2 cooling tower and closed type cooling system for 1,500 brake hp. of Diesel oil and overload storage tank and auxiliaries; Cont. 3 switchboard and switching equipment with wiring, conduits and auxiliaries for proposed power plant improvements.

Generating Unit—Norfolk, Mass.—Dept. of Correction, State House, will receive bids until Sept. 18, for a turbine generating unit and switchboard complete at State Prison Colony.

Pumps—Cornwall, Ont.—Town plans to purchase one 3,900 to 5,000 g.p.m. and 2,500 g.p.m. pumps and one booster pump all electrically driven.

Transformers—Wellington, N. Z.—Dept. of Public Works, will receive bids until Nov. 17, for four 3,333 kva. oil immersed self controlled transformers

Industrial Projects

Conn., Bridgeport—Bridgeport Window Shade Co., 197 Stratford Ave., had plans prepared for a 2 story, 62 x 100 ft. factory on Fairfield Ave. Estimated cost $40,000. A. Pokras, Community Bldg., Fairfield, is architect.

Me., Dixfield—Berst-Foster-Dixfield Co., F. W. Smith, Mgr., West Peru, manufacturers of wood products, is receiving bids for a 3 story, 105 x 200 ft. factory. Estimated cost, $40,000. H. F. Hallock, Oswego, N. H., is architect.

Mass., North Wilbraham—Collins Mfg. Co., 56 Suffolk St., Holyoke, awarded contract for the construction of a 1 story power house on Main St. to Casper Ranger Construction Co., 6 Newton St., Holyoke. Estimated cost $50,000.

Mich., Ecorse—Murray Body Corp., Clay Ave., Detroit, awarded contract for the construction of a 1 story, 100 x 300 ft. body factory here to Otto Misch Co., 159 East Columbia St., Detroit.

Mo., St. Louis—Pittsburgh Erie Saw Corp., 704 South 4th St., awarded contract for the construction of a 1 and 2 story, 50 x 254 ft. saw manufacturing plant on Tower Grove to William H. and Nelson Cunliffe Co., 3327 Lindell St. Estimated cost $80,000.

N. J., Absecon—Metal Edge Fiber Products Co., awarded contract for the construction of a 2 story, 50 x 150 ft. factory at Ohio Ave. between Mill and New Roads to Brown Bros., Atlantic City. Estimated cost $40,000.

N. J., South Amboy — United Lead Co., Maurer, plans the construction of a factory here. Estimated cost $40,000. Architect not selected.

N. Y., New York—Baird Television Corp., 145 West 45th St., plans the construction of a plant for the manufacture and assembling of parts. Estimated cost to exceed $40,000, including equipment.

Tex., Viola—Houston Oil Co., Petroleum Bldg., Houston, postponed construction of oil refinery here. Estimated cost, $250,000. Private plans. May mature later.